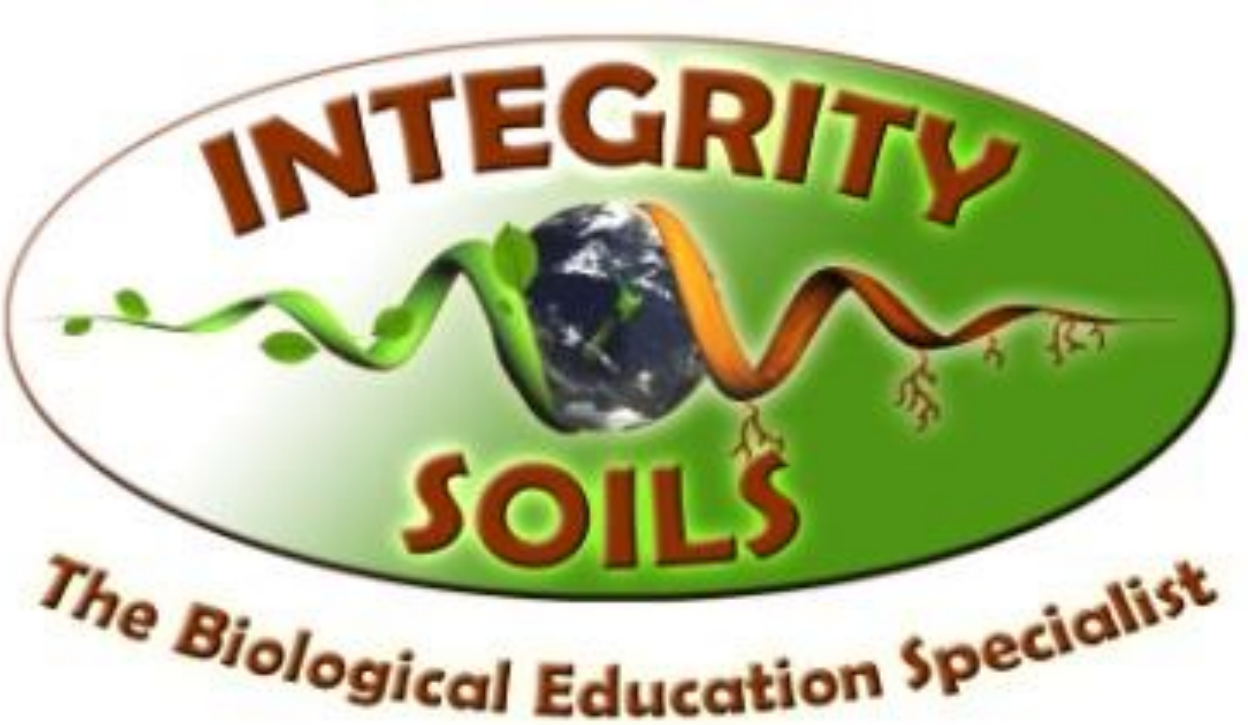
Waste + Worms = Wealth



Vermicomposting Outline

- Why worms?
- Livestock management and worm composting basics
- Feeding worms
- Setting up a worm farm
  - Trouble-shooting
- Harvesting
- Using the products

Fungal dominated vermicast

See TVOne on Demand; Country Calendar May 2015
“The Good Earth”

White wood species:

Poplar, willow, birch, beech, elm, alder and cottonwood

Feed stock for worms

White wood chip
Manure-horse/cow/pig
Grass
Cardboard
Dusting of lime and rock P

What waste resources do you have?

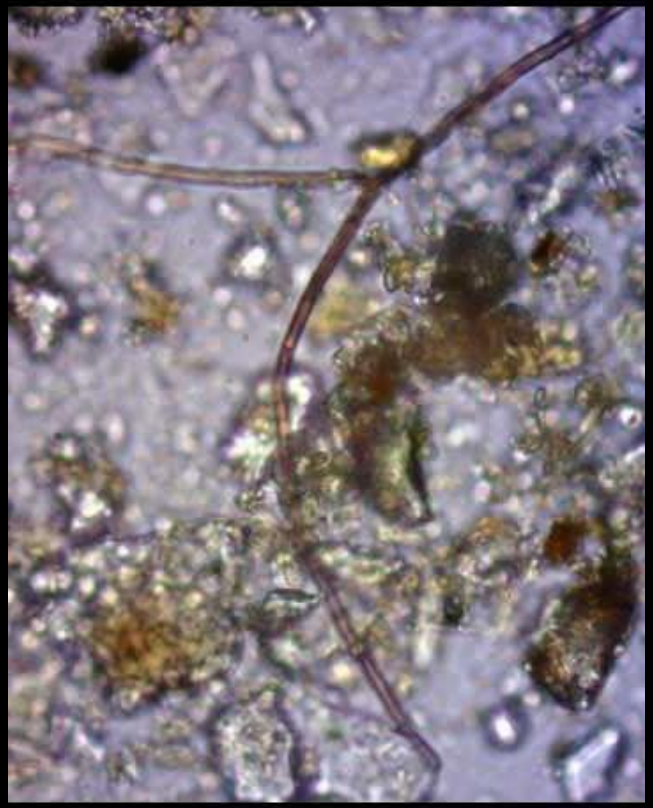
Some of the benefits of vermicast:

- Contains - Plant available nutrients, vitamins and enzymes.
- Natural antibiotics and growth hormones.
- Humic acids and other soil conditioners.

Some more benefits

Vermicast is biologically alive:

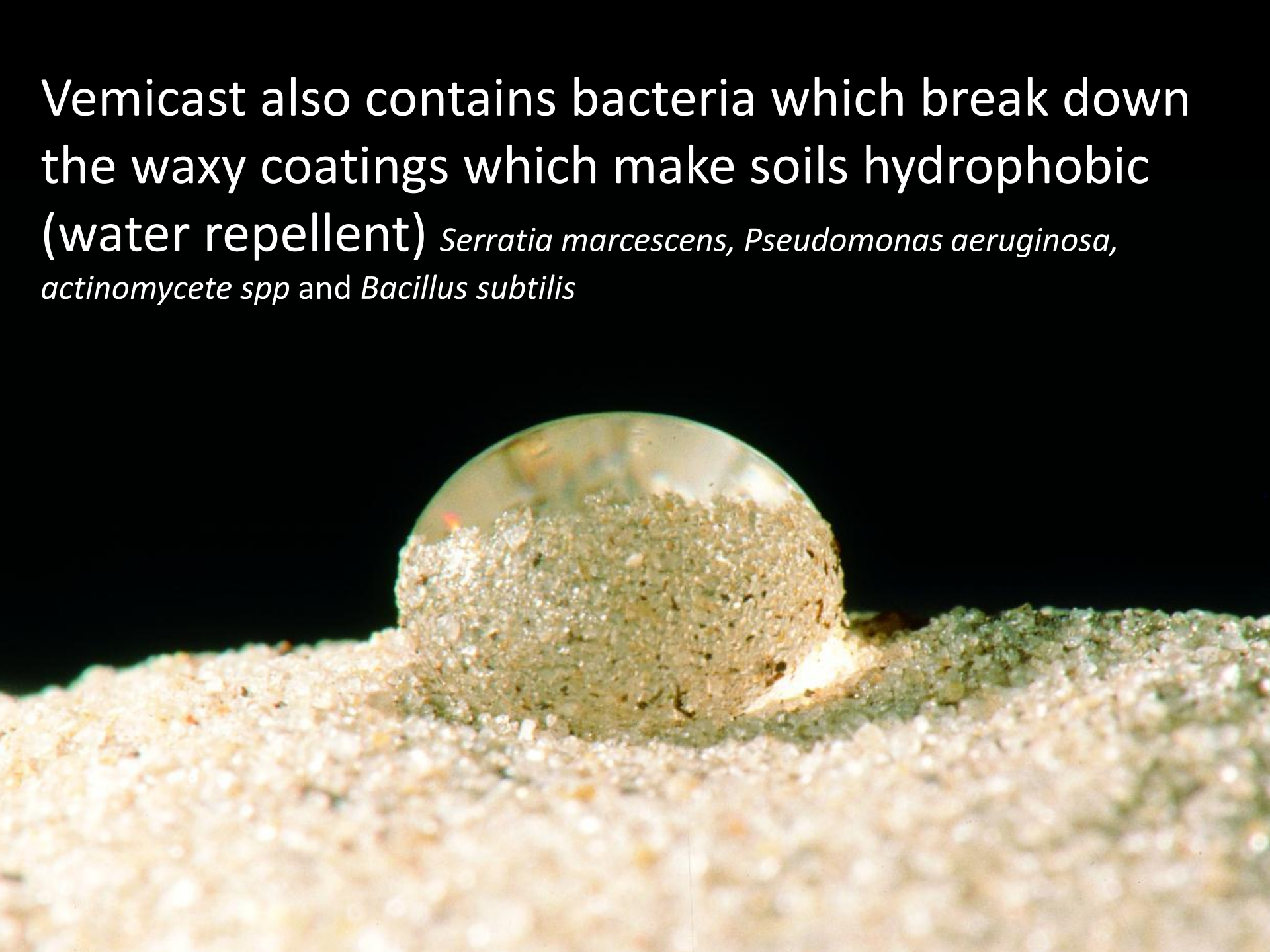
- N-fixing bacteria, Trichoderma, Phosphate Solubilizing Bacteria (PSB), antibiotic releasing bacteria
- Nematodes, fungi, bacteria and protozoa which convert soil nutrients into plant-soluble forms



And even more benefits

- Vermicast contains bacteria which eat the bacteria that make frost
  - Pseudomonas syringae – ice nucleating bacteria
  - P. flourenscens (frost fighters down to 20^{o} F)

Vemicast also contains bacteria which break down the waxy coatings which make soils hydrophobic (water repellent) *Serratia marcescens, Pseudomonas aeruginosa, actinomycete spp* and *Bacillus subtilis*



Giving the following results…

- Improved soil structure
- Improves root growth – depth and density
- Increase moisture retention
- Improve sward palatability & nutrient density
- Increase resistance to pests and pathogens
- Reduce heavy metal toxicity
- Reduce frost damage and environmental stress
- Increase soil microbes and increase earthworms numbers
- Reduce fertiliser requirements and increases fertilisers efficiencies

Why worms?

- Converts effluent and other organic waste streams into a high quality product
- Superior inoculant
- Vermiculture offers on-ranch enterprise
- Reduces the need for bought-in fertiliser

Downsides compared to compost

- It can be quicker to make, but generally requires more labour - feeding
- It requires more space because worms are surface feeders and are ineffective in material deeper than 3 feet
- It is more vulnerable to environmental pressures
- Starter costs - buying in worms (or not?)

Compost Worms

- They are NOT Earthworms

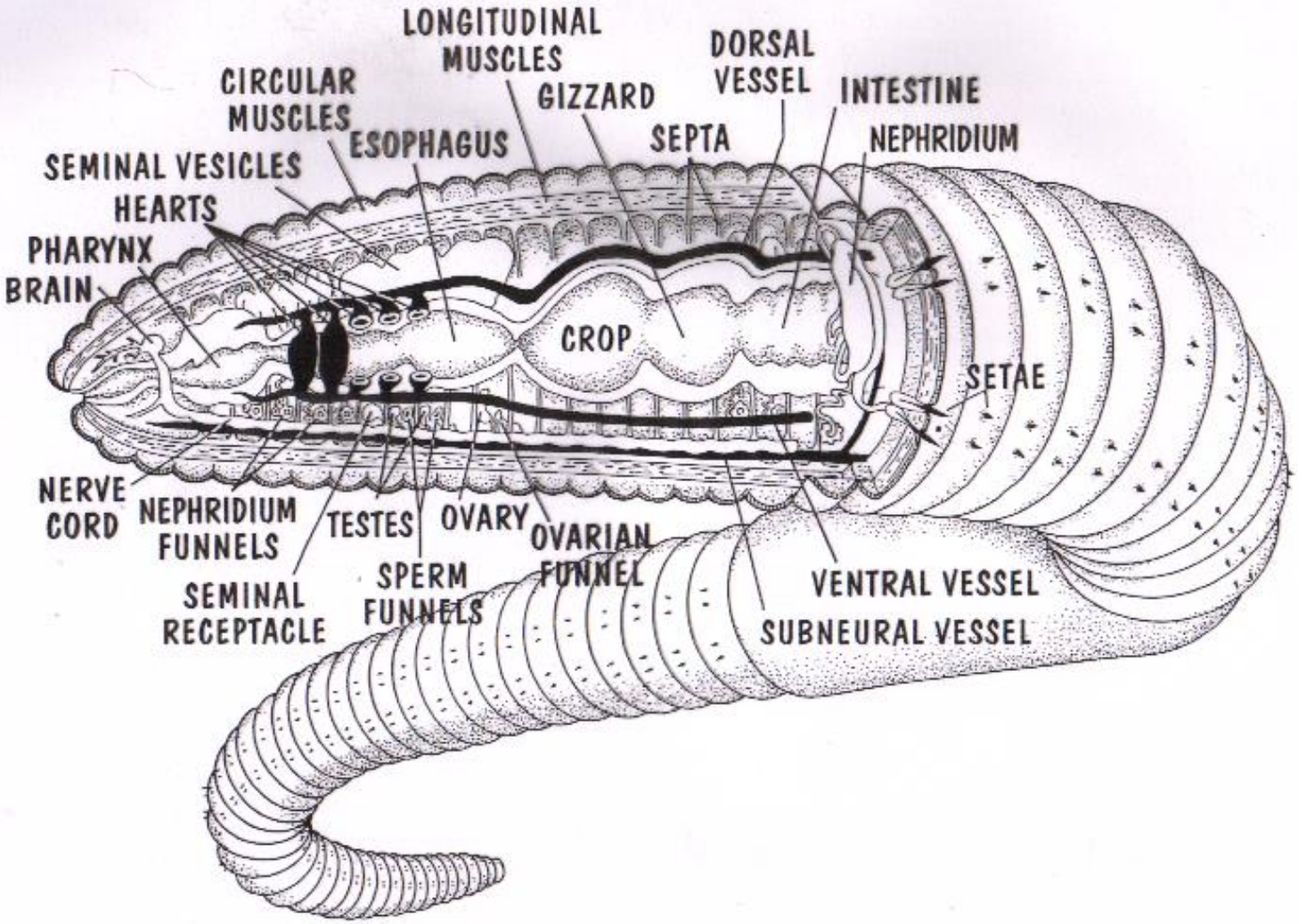
- Found in compost, manures and travel through the top 6” of soil

Composting worm species

Tiger *worms* (Eisenia Foetida)

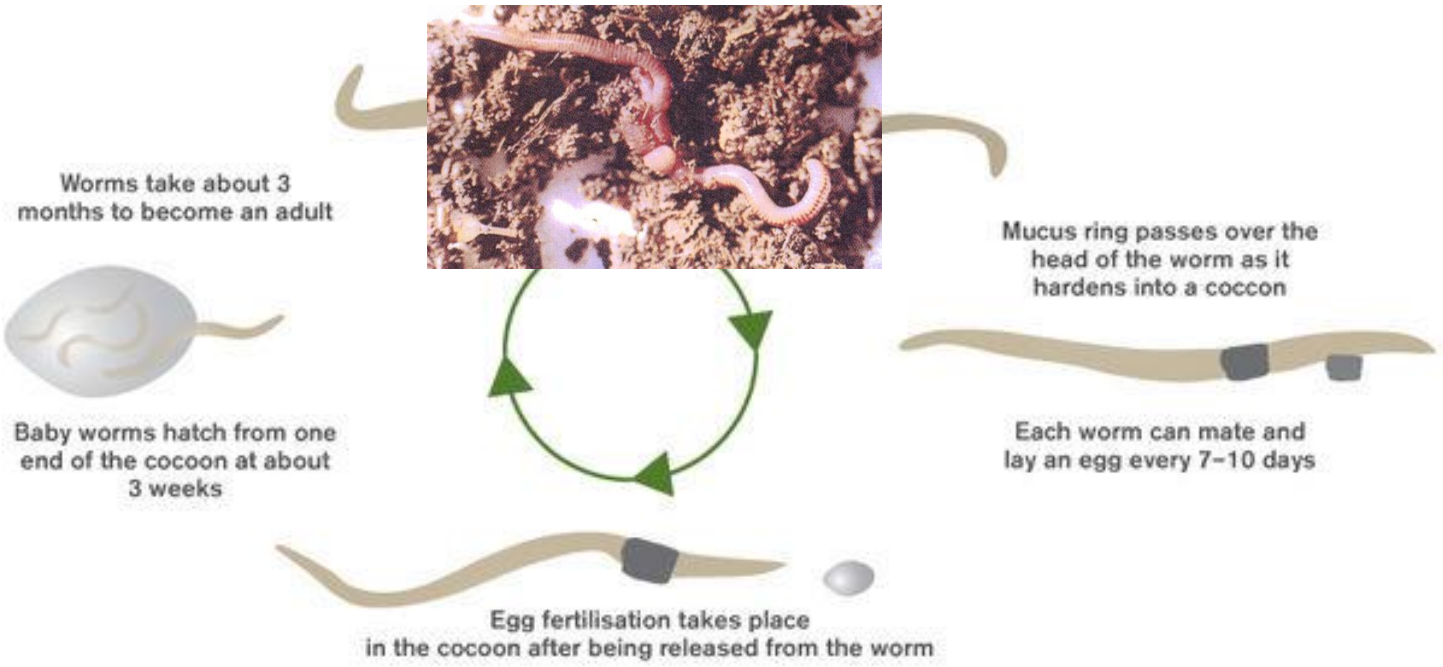
Red *Worms* (Lumbricus Rubellus)

Indian Blue (Perionyx Excavatus)


LONGITUDINAL MUSCLES
DORSAL VESSEL
CIRCULAR MUSCLES
GIZZARD
INTESTINE
ESOPHAGUS
SEPTA
NEPHRIDIUM
SEMINAL VESICLES
HEARTS
PHARYNX
BRAIN
CROP
SETAE
NERVE CORD
NEPHRIDIUM FUNNELS
TESTES
OVARY
OVARIAN FUNNEL
SEMINAL RECEPTACLE
SPERM FUNNELS
VENTRAL VESSEL
SUBNEURAL VESSEL

Breeding cycle

- Population can double every 2 months under ideal conditions
  - eg starting with 10 lbs = 640 lb in one year
    = 40,000 lbs in 2 years!!!



Livestock requirements

1. Bedding
2. Food
3. Air
4. Water
5. Temperature

1. Bedding materials

- A stable worm retreat with these characteristics:
  - Non-heating, low nitrogen, high carbon
  - High water absorbency
  - Good airflow
- Eg horse manure, rotten haylage/straw, newspaper, cardboard

Making the bed

2. Worm feeding

- Worms can survive solely on cow manure

- BUT, we want to make the best product imaginable

  = diversity, diversity, diversity!!

Worm Feeding

- Carbon: Nitrogen ratio vital.
- Carbon = Brown, dry materials; leaves, straw, bark, paper, cardboard...
- Nitrogen = Green, wet materials; manure, grass, silage, vegetable and fruit scraps.

Carbon: Nitrogen Ratio

- Optimum C:N ratio 30:1 (weight basis)
- Target range 20:1 – 40:1

Product	C:N
Fresh Poultry manure	10:1
Fresh cattle manure	20:1
Fresh horse manure	25:1
bark	100-300:1
Aged sawdust	<100:1
Vegetable waste	13:1
Grass clippings	12-25:1

MATERIAL INPUTS

BROWN

- STRAW
- WOOD CHIPS-WILLOW/POPLAR
- WOOD SHAVINGS
- CARD BOARD
- SHREDDED PAPER
- DRY LEAVES
- SPENT MUSHROOM
- OLD PEAT

GREEN

- GRASS
- GREEN LEAVES
- HERBAL LEY
- JUICING PRESS
- SEA LETTUCE
- FRUIT & VEGES
- MANURES

MATERIAL INPUTS

MANURES

- LAYER HENS
- BROILER CHICKEN
- STABLE MANURE
- FARM YARD
- GOAT & SHEEP
- PIG MANURE

EXTRA STIMULANTS

- BOKASHI, EM
- FOREST LEAF LITTER
- BLOOD AND BONE
- MOLASSES
- BRAN/OATS
- FISH

General recipe

- **BROWN – 30% for bacterial compost**
  -40 % for fungal compost
- **GREEN – 60-70%**
- **MINERALS: PARAMAGNETIC ROCK DUSTS, RPR, LIME**

Additives

- Finished inoculated compost
- Blood (nitrogen)
- Bone meal (adds P, Ca)
- Clay
- Seaweed meal
- Molasses
- Bokashi / EM
- Bran/Oats
- Fish

3. Air

- Good carbon levels help to ensure airflow
- Avoid overdoing the nitrogen or overwatering

4. Moisture

- Should be around 70%
- Squeeze test: should feel damp; material should retain clumped shape and not drip water after squeezing
- Too wet: odours, compaction, anaerobic conditions
- Too dry: worms will stop working, shrivel up

Moisture

- Too wet? Add dry bulking agents, such as straw, coarse sawdust, shredded cardboard & use good quality covers

- Too dry? Add water or liquids such as slurries

Carbon for bulking

- Finished vermicast can end up being 10-50% of the original volume,
  - Add more carbon to bulk it up

- Eg add as little as 5% poultry manure, by volume to shredded paper and cardboard
  - Results in 50% of the initial input weight.

5. Temperature

- Ideally around 20-26 °C (70-80°F) worms can survive in temperatures 0-38 °C (30°C–100°F)
- Keep covered to prevent over-heating/drying out in summer

Winter Management

- Add deeper layers of food to encourage a composting action- produces heat
- Add 1’ deep layer of hay/straw
- Trenches -2-4’ deep

Worm farms can be very simple

On ground

Site requirements

- Gently sloping area, preferably a pad, which can capture any possible leachate
- All weather surface

Site considerations

- Council plans?
- Buffer zones/ Sensitive areas?
- Dust/noise/odour control
- Operator health

Feeding: little and often


2

Effluent

Feed in strips along top of windrow, no deeper than 4 inches

Test for salts or affects from wormers etc-

Use the ice cream container test

= dead worms
DON'T USE!!!

Keys to Success

- Food: avoid overfeeding. Keep up the Carbon.
- Temperature
- Moisture
- Air
- Lime

Setting up

- start 1 kg m2 (2.5 lbs worms/yd$^{2)}$
- A prepared base
- Bedding
- Food
- Cover
- Access to water (if not using slurries

Production

- Worms will process 50-80% of their body weight a day
- Each m2 = 2kg waste/day
- Say 2m wide bed x 100m = feed 400kg/day

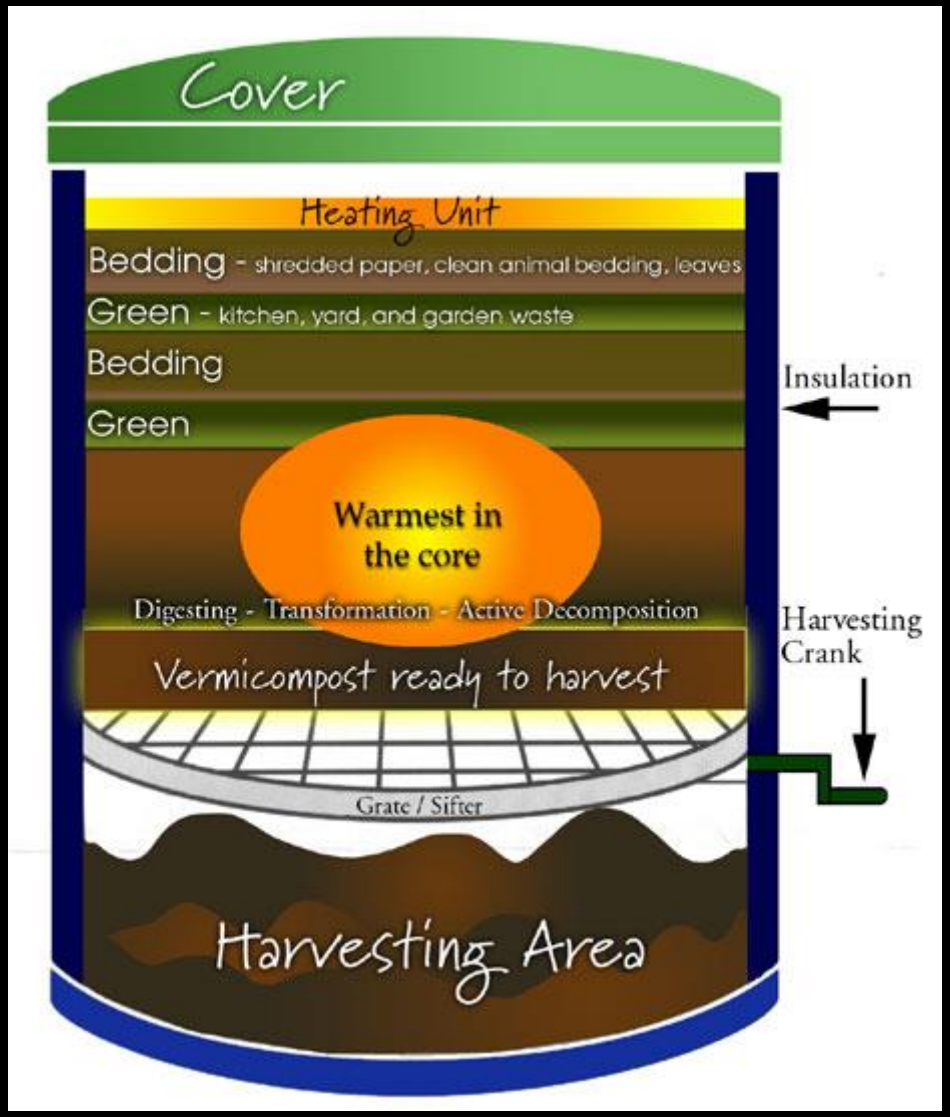
= 130 kg vermicast/day

(approx $100-$280 a day!)

Other designs

Tat-g

Wedge


Cover
Heating Unit
Bedding - shredded paper, clean animal bedding, leaves
Green - kitchen, yard, and garden waste
Bedding
Green
Warmest in the core
Digesting - Transformation - Active Decomposition
Vermicompost ready to harvest
Grate / Sifter
Harvesting Area
Insulation
Harvesting Crank

Troubleshooting

Soldier fly larvae

Smells?
Insect pests?
Vermin?

Trouble shooting

- If you have been following the principles so far, you won't need to troubleshoot!
- Key is to get the moisture, air, food and acidity balances right
- Can be an art

  = experience & confidence

Harvesting

- Harvest vermicast before the rows reach 3 feet depth
- Scrape off top 6”

– most worms will be there

Harvesting castings

EC / Conductivity

- EC can be used to test when the vermicast has finished breaking down
- Mix 1 part castings to 30 water
- EC shows the conductivity or salt reading of the solution
  - 1.5-3 mS/cm range ideal
  - Less than 1.2 unlikely to create a plant response
  - Over 7 may burn foliage

End product

- Turning organic waste into casts takes 22–32 days depending on materials
- Vermicast does not need curing, but fresh casts need 2 weeks for nitrification
  - NH_4 to NO_3
- If you wish to sell and package it

then a drying process is required

Nutrients

- Vermicast nutrient content varies with earthworm feed type
- A typical nutrient analysis of casts is C:N ratio 12–15:1

  : 1.5%–2.5% N, 1.25%–2.25% P_2O_5 and 1%–2%, K_2O

Savings

- Vermicast can be purchased from $400-$1700 yd^3
  - Depending on the quality
  - Niche markets- marijuana, compost tea, extracts
- The value in nutrients

Value

Lets say 100 kg of DAP is used per hectare. Cost of DAP per kg is $10.50 = $105

This contains 18 percent nitrogen and 46 percent phosphorus.

Plant uptake i,.e. use efficiency is 15-40 percent for nitrogen (average 20%) and 10-25 percent for phosphorus (average 15%).

The cost of nutrients actually used by the plants from DAP is $1.55/- per kg.

The average nutrients contents reported for vermicast are nitrogen-(average 2%), phosphorus-(average 1.75%), potassium (average 1.5%).

In addition vermicast contains all micronutrients and trace elements, that would also add up to at least 1% equivalent of nutrients.

The vermicast has active biological life containing Azatobactor, PSB, PGPR, etc. During 90-100 days of crop duration they also add up to 1.5 to 2.5 percent nutrients (average 2%).

If 1000 kg of vermicast is used per hectare.

The total nutrients provided by 1000 kg of vermicast will add up to 82.50 per kg (8.25%) and at an average plant uptake i.e. use efficiency of 65 percent will provide 53.60 kgs of nutrients.

At an average cost of vermicast at $300/- per m3 per hectare, the value of nutrients is $18.50/- per kg applied

Separating worms

- place fresh feed at the opposite end of the continuous flow system, attracting them away from the finished vermicast
- mechanical sieving by a drum screen or a moving grate at the bottom of a bin or raised bed
- mild heating
- drying the vermicast materials with a fan in a batch process, diverting worms to moister material
- Light extraction

Worm harvesting

- Trommel screen
- Mesh width ¼” -1/8”

Quality vermicast:
suppresses diseases, builds soil structure, restores water cycles, microbial home.
It is humified and granular of structure and smells nice.

Check if your vermicast can suppress diseases….!!!!

Germination test

- Use radishes – or any fast germinating seed
- Looking for 100% with no damping down or yellowing
- Weeds?

Solid Applications

- On average 750 kg/ha
- Apply in late autumn, early spring
- Better results if covered or incorporated
- Apply before wet seasons or to longer pastures to shade it
- Research shows 4-7 year benefit from heavier applications

Solid Applications

Liquid Applications

- Tickle the system!
- 0.5-2 gallons extract/acre
- Repeat applications to kick start system

Liquid Application Specs

- Trash pumps or diaphragm pumps with no compression points ideal
- Below 80psi, with filters larger than 400um
- Test your brew before and after to check microbes are alive

Bottom Line

- Disease suppression
- Plant quality and Yield
- Nutrient and water cycling
- Buffer to climate
- More $$$ in the bank