Drilosphere

It is the part of soil influenced by earthworm secretion and castings or it is the fraction of soil or the lining of earthworm burrow, the average thickness of drilosphere is 2mm. The drilosphere contains lot of microbes responsible for nitrogen fixation, organic matter decomposition, phosphate solubilization, humification, denitrification, involved biogeochemical cycling e.g ; nitrogen, carbon, phosphorus, calcium, magnesium, iron, sulphur etc.

Both aerobic and anaerobic bacteria are present. The drilosphere word was coined by Bouche. Invertebrate population also present in drilosphere. It act as **hot spots** for microbial activities.

The microbial communities are constantly changed, responsible for changing physical and chemical properties of soil.

Ecological classification of earthworms

Three types

1, Epigeics
2, Anecics
3, Endogeics

Epigeics

These are earthworms responsible for litter transformation, they can consume and digest organic matter and decaying litter. , responsible for releasing of nutrients from organic matter, the foregut of earthworm contains microbes(bacteria, fungi, protozoa) releasing enzymes which digest complex organic materials and antibiotics substances which kills the *Vibrio* spp , e.g; *Eisenia fetida*(a composting earthworm) *E. andrei and Perionyx excavates*.

Anecics

These are vertically burrowing species, dominant earthworms in temperate regions, found in the middle region of soil is called as middens, they can assimilate 10% of litter, these are responsible for humus formation, this earthworms responsible for re-digestion of casting materials due to fungal colonization.

E.g ; *Lumbricus terrestris* ,this earthworms cast contains high amount of nitrogen, carbon, phosphorus and calcium and high number of fungi and protozoa. The drilosphere soil contain many number of cellulolytic, hemicellulolytic and proteolytic bacteria are present. This earth worm disperse VAM(Vesicular and Arbuscular Mycorrhizae- phosphate solubilizer), Rhizobia(nitrogen fixing bacteria) and eliminate pathogenic microbes from drilosphere soil.

Endogeics

This earthworm mostly present in agroecosystem and tropical environments. These are geophagous (rhizosphere soil eaters), it produce two types of casts 1, granular 2, globular. Endogeic casts contain more amount of clay and organic matter and low amount of undigested soil, e,g ; The casts of *Pontoscolex corethrurus* contain more amount of inorganic compound phosphorus and $NH_{4\ (ammonium\ ion)}$ than undigested soil. This worm responsible for **mineralization**, it means conversion of organic into inorganic compound.

Gut microflora of endogeic contain fungus, protozoa, algae, myxomycetes, nematodes. This earth worm disperse VAM(Vesicular and Arbuscular Mycorrhizae-phosphate solubilizer), *Frankia* – (nitrogen fixing actinomycetes) *Rhizobia* (nitrogen fixing bacteria) and eliminate pathogenic microbes from drilosphere soil. This earthworm selectively ingest large amount of organic matter, but assimilate only low amount of organic matter, egesting(worm cast) large amount of carbon containing casts. This worms responsible for organic matter or litter transformation.

Physical and chemical factors that affects the growth of earthworms .

Earthworms are invertebrate, found in soil environment, Based on their feeding habitat, burrowing activities and casting activities the earthworms are called as ecosystem engineeers. it will change the physical chemical and biological properties of soil, earthworms are important macro fauna of the rhizosphere , decomposer in food-web, consume large quantities of organic matter and soil

It will mix large quantities of plant remains and soil and create pores through their casting and burrowing activities are carried out.

Eearthworms are enhancing mineralization and nutrient availability in soil , transformation of minerals and increase the plant nutrients to soil and improve the crop yield.

Physical factors

Temperature – The temperature 25- 30^0C enhance the growth of earthworms, high or low temperature decrease the growth of earthworms.

pH - around 7 pH better for earthworms, alkali and acidic pH decrease the growth of earthworms.

Monsoon (rainy)season will improve the growth of earthworms. Water logging decreases the growth

Chemical factors

Nutrient - Soil enriched with organic matter and improve the growth of earthworms. Soil with poor organic matter decrease the growth of earthworms.

Water - Wet soil improve the growth of earthworms. Dry soil decrease the growth of earthworms.

Pesticides- spraying pesticide and applying chemical fertilizers inhibits the growth of of earthworms.

Biological factors

predators such as frog, eagle, ant, rat, cat, and snake, they will kill and eat the earthworms

Vermiwash

a liquid fertilizer collected from worm cultivated tank , and is very useful as a foliar spray. It contains plant growth hormones like auxins and cytokinin apart from nitrogen, phosphorus, potash and other micro nutrients. It contains nitrogen fixing bacteria like *Azotobacter sp*., *Arobactericum sp*. and *Rhizobium sp*. and some phosphate solublizing bacteria. It acts as a plant tonic and helps to reduce many plant diseases.

Benefits of Vermiwash

Vermiwash acts as a plant tonic and helps to reduce many plant diseases A mixture of Vermiwash (1litre) with cow urine (1litre) in 10 liters of water acts as bio-pesticides and liquid manure. Increases the rate of photo synthesis in crop / plant Increases the number of micro-organisms in the soil. Increases the crop yield. Increases the resistance to pest and diseases. Increases the rate of decomposition of compost

Principle of Vermiwash production

The secretions of the earthworm along with it and also other nutrients from the decomposed material. The collected water contains many nutrients readily available to the crop plants.

Micro-nutrients(for plants) in Vermiwash

No. Nutrient Quantity (ppm), or micronutrient level

1. Sodium 8 ± 1
2. Calcium 3 ± 1
3. Copper 0.01 ± 0.001
4. Ferrous 0.06 ± 0.001
5. Magnesium 158.44 ± 23.42
6. Manganese 0.58 ± 0.040
7. Zinc 0.02 ± 0.001

Microbial composition of Vermiwash

. Microbes Microbial count (CFU/ml)

1. Total heterotrophs 1.79×10^3
2. Nitrosomonas sp. 1.01×10^3
3. Nitrobacter sp. 1.12×10^3
4. Total fungi 1.46×10^3

Requirements for the production of Vermiwash

Bucket with tap

Earthworms

Cow dung

Method of preparation of Vermiwash

Select one sufficiently large container made of concrete or plastic bucket. Drill a hole at the base of the container to fix a tap to it. Introduce about 2000 earthworms into the container. A base layer of gravel or broken small pieces of bricks are placed up to height of 10-15 cm. On the coarse sand layer place 40-45 cm pre-decomposed organic wastes and moisten the different layers by using water. To get vermiwash continuously . Fill the container with 4-5 lits water everyday, after 10 days vermiwash starts, Everyday about 3-4 lits of vermiwash can be collected.

Collection :

The tap should be always kept open to collect the washings. The unit starts yielding good quality Vermiwash after ten days. The Vermiwash is coppery brown in color Vermiwash should be stored in cool dry place.

Vermicuture – refers cultivation of earthworms is called as vermiculture,


Composting (10 cm)
Cow dung (5cm)
Earthworms (Eudrilus eugeniae)
Cow dung (5cm)
Soil + Composting (15 cm)
Broken bricks (10cm)

Dosage for Use

Root dip/Stem dip.

- The seedlings before transplanting are dipped in Vermiwash solution which is diluted 5 times with water for 15-20 minutes and then transplanted. Similarly the cuttings(sugarcane setts) can also be dipped in the solution.

Foliar spray

- Vermiwash is diluted in water 5 times and sprayed on the foliage of crops. It provides the plant with vital nutrients but also helps to control plant disease.

Soil drench(soil soaking)

- Vermiwash is diluted 10 times with water and the soil is drenched with the solution to prevent some of the soil borne pathogens.