Earthworm manure and fertilizer: mechanisms and efficacy

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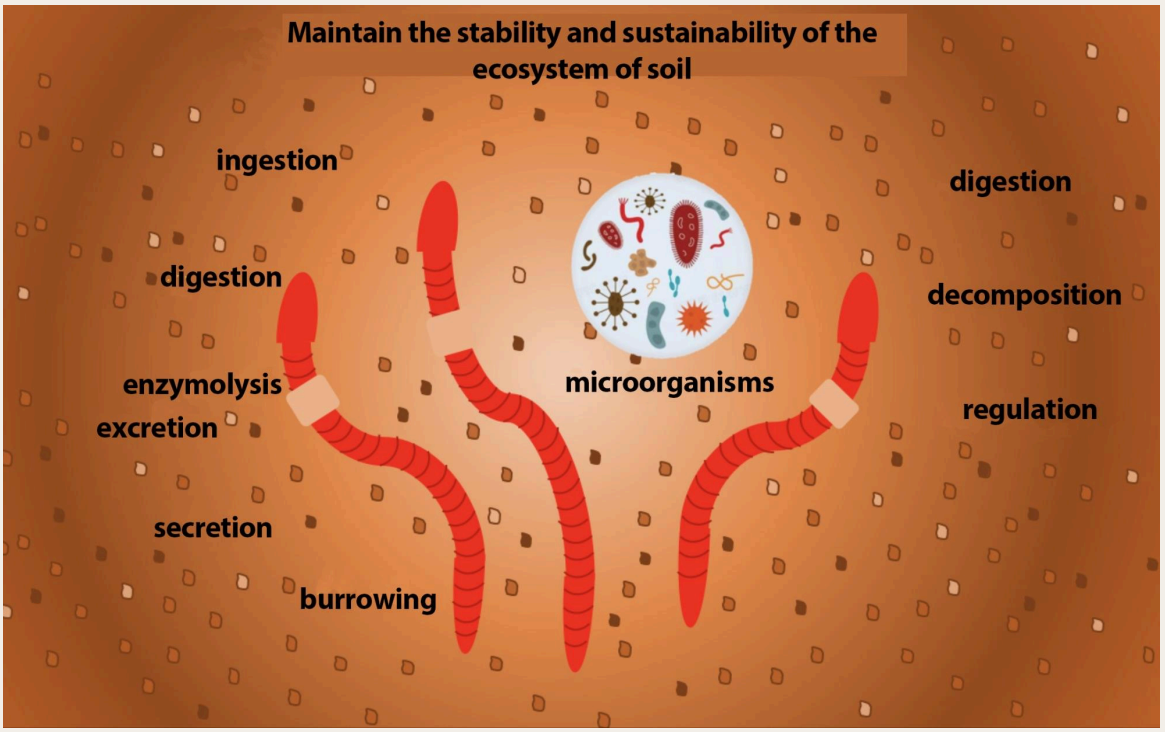
Earthworms are the engineers of the earth's soil ecosystems, having existed more than 500 million years ago during the Cambrian period, and have survived the biological extinction of the Permian period, the Triassic period, and the Jurassic period, which were the life-and-death tests of biological evolution 240 million years ago. Earthworms play an important role in digestion, decomposition, regulation, and sustainability in the soil ecosystem, and play a great role in the soil's material cycle, microflora metabolism, ecological balance, and energy transfer through their activities of ingestion, digestion, enzymolysis, excretion, secretion, and burrowing.

The ecological significance of earthworms lies, on the one hand, in the movement of earthworms, which promotes soil ventilation and air permeability, improves soil structure, and improves soil performance; on the other hand, it is through the swallowing and digestion of organic matter in the soil by earthworms, which promotes the decomposition of organic matter for plant recycling; and thirdly, and most importantly, it is the formation, balancing and sustainability of soil microbial ecosystems in the soil through the intestinal tract of

earthworms.



Roles of the earthworms in soil ecosystem.

Chinese microbial and soil researchers have found that not only are earthworms important for soil and ecology, but vermicompost is also important for soil and ecology. Compared to earthworms, vermicompost is easier to utilize, use, and popularize. The biologist Darwin highly values the contribution of earthworm manure to soil fertility.

According to research, an adult earthworm swallows about seven times its body weight per day, and one ton of earthworms swallow about seven tons of soil daily. The average earthworm weighs about 10 grams and has an average lifespan of more than three years. In other words, one earthworm forms about 20 kilograms of manure a year, which is a large amount. Therefore, vermicompost is very easy to obtain and inexpensive.

Vermicompost contains a large number of bacterial flora. The number of bacteria in each gram of vermicompost reaches between 20 million and 200 million. Moreover, these flora are ecologically stable and have self-repairing functions as earthworms do, and the earthworm flora is highly adaptable, sustainable, and regenerative. This lays a solid and feasible ecological foundation for effectively utilizing

vermicompost.

Enzymes, the excretions of different bacteria in the vermicompost colony, become the substrate for another kind of bacteria or provide nutrition for them, forming a cyclic effect of bacterial-enzyme coordination and complementarity, which greatly exerts the role of ecological balance, complementarity, and restoration, and provides another solid and feasible ecological foundation for the effective full utilization of vermicompost.

Earthworm manure which is made up of nutrients from the original materials, earthworm bacteria, and bacterial metabolites, has been successfully used by researchers to create an innovative kind of organic fertilizer. Additional plant and animal sources of micronutrients and critical elements are added to this special blend to produce a harmonious balance between the fertilizer and its constituent parts. The fertilizers produced are with high nitrogen, phosphorus, and potassium content based on earthworm manure, as well as water-soluble fertilizers based on amino acids, humic acid, and vermicompost extract, which has greatly improved the utilization value of earthworm manure.

Solid organic fertilizer series using earthworm manure as substrate

With earthworm manure as the main raw material, together with the raw materials containing high nitrogen, phosphorus, and potassium organic matter, it is nutritionally comprehensive and rich in earthworm flora, which has a very positive effect on soil improvement, enhancing ground strength, providing nutrition, regulating crop growth and suppressing soil-borne diseases.

Soil improvement: Using earthworm manure can significantly improve soil quality by breaking down particles into uniform sizes, enhancing water retention, and increasing air permeability. This process also accelerates the formation of soil granular structure, which addresses the issue of soil compaction and enhances soil permeability, water retention, and fertilizer retention. Moreover, it fosters a healthy environment for soil microorganisms to thrive, promoting their reproduction and overall soil ecosystem health.

Farmers apply solid organic fertilizer based on earthworm manure as substrate. Photo from the author.

Enhances soil power: Earthworm manure is rich in organic matter, and humus. It also contains a variety of digestive enzymes and substances that can neutralize the soil pH and, after application can enhance the ground power and regulate the soil pH. At the same time, earthworm manure contains a large number of beneficial microorganisms, which can promote the decomposition of soil nutrients and transformation, and improve the fertility of the soil.

Provides nutrition: Earthworm substrate organic fertilizer contains nitrogen, phosphorus, potassium, and other large elements. It also contains 18 kinds of amino acids and various trace elements, which

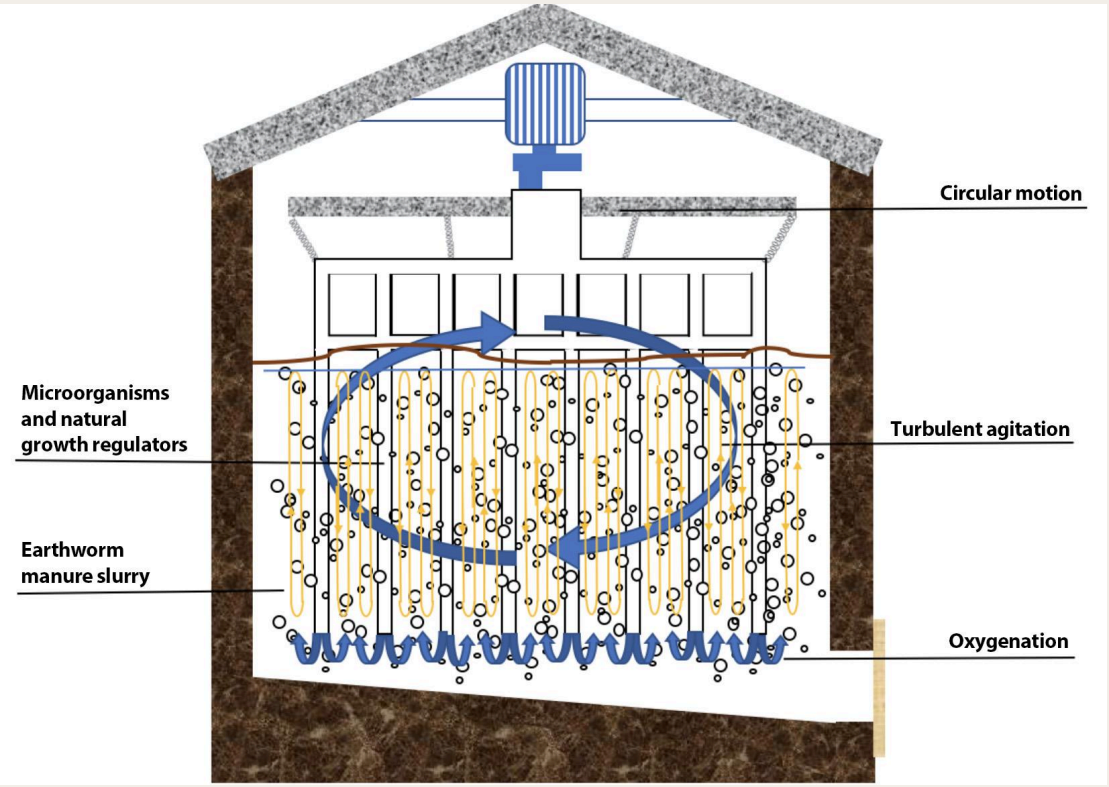
can be absorbed and used by the crop. With organic fertilizer, amino acid fertilizer, humic acid fertilizer, bacterial fertilizer, and micro-fertilizer characteristics alongside the earthworm's hundreds of millions of years of evolutionary process gradually formed by the combination of the suitable crop for growth.

Regulates crop growth: Earthworm manure contains indole acetic acid, gibberellin, and other unknown plant growth factors, which promote plant cell division and regulate plant growth.

Inhibits the occurrence of soil-borne diseases: Vermicompost contains more beneficial microorganisms, which can rapidly colonize the soil and displace harmful microorganisms, effectively preventing the spread of soil-borne diseases.

Organic water-soluble fertilizer series based on earthworm manure extracts

The earthworm manure is extracted by using rotted cow dung and straw to cultivate earthworms, and then specific turbulent agitation patented technology is used to obtain the extracted liquid of earthworm manure. The extracted liquid is then used as the "mother liquor" for the production of earthworm manure substrate organic water-soluble fertilizer. The main process is to mix earthworm manure and water according to a certain proportion in specific equipment, oxygenation, agitation, leaching, and earthworm manure substrate solution. Afterward, the earthworm manure is mixed with a certain proportion of organic materials from animal and plant sources to create an earthworm manure extract matrix, which is then dissolved in water to produce an organic water-soluble fertilizer. The application of the liquid fertilizer improves the properties of the soil and increases crop resistance, growth, and nutrition.



Schematic diagram - Earthworm liquid fertilizer turbulent agitation patent.

Improves soil properties: The application of earthworm liquid organic water-soluble fertilizer to crop roots and soil improves the soil's physical properties, humic acid content, and organic matter. Beneficial microorganisms that stimulate soils and encourage the transformation and absorption of soil nutrients are also included in the earthworm liquid organic water-soluble fertilizer.

Improves crop resistance: The earthworm substrate solution has a large number of beneficial biological defense microorganisms which provide crops with a good micro-ecological environment and promote crop growth and development, enhancing crop resistance to disease.

Promotes crop growth: The earthworm manure in the natural growth of substances IAA (Indole-3-acetic acid) and Gibberellins (GAs) in the process of vermicompost substrate solution production has been dissolved, so vermicompost liquid organic fertilizer for root growth, plant germination, and leaf growth has a better role in promoting.

Organic water-soluble fertilizer based on earthworm manure extracts. Photo from the author.

Improves crop nutrition level: Vermicompost liquid fertilizer organic water-soluble fertilizers rich in organic matter, large amounts of elements, and various types of trace elements can provide sustained nutrition for crop growth in the late stages, for high yield, high quality, and high efficiency of crops to provide a favorable guarantee.

Flush foliar can be applied: The earthworm liquid organic water-soluble fertilizer can be made as a flush fertilizer and/or a foliar fertilizer can be drip irrigation, can also be sprinkler irrigation, do not block the nozzle, is the first choice of liquid fertilizers for the integration of water and fertilizer in facility agriculture.