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Vermicompost: An Effective Method of Converting Crop Waste to Gold

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Summary:

Generally people burned the useful crop waste on the field which arose problems like soil degradation, low crop productivity and adverse effect on environments. Therefore to overcome these problems crop waste management is done which includes a variety of technologies such as bio-fuel, bioenergy, compost and vermicompost. Among these technologies, the best and widely used technology for crop waste management is vermicomposting because of recycling of crop waste into valuable and quality product (vermicompost).

Introduction:

Crop waste is plant material that remains in the field after crops have been harvested and threshed. Global crop waste availability is estimated to be around 3.8 billion tonnes per year, with cereals accounting for 74 %, legumes accounting for 8 %, oil crops accounting for 3 %, sugar crops accounting for 10 %, and tubers accounting for 5 % (Lal, 2005). Crop waste potential in India is estimated to be around 550 million tonnes per year. For instance, it has been estimated that 30–35% nitrogen and phosphorus and 70–80% of potassium applied as the nutrient input remain available in the crop wastes while average major nutrient content noted in different crop waste like in rice 0.61 % nitrogen, 0.09 % phosphorous and 1.15 % potassium, in sugarcane 0.45 % nitrogen, 0.08 % phosphorous and 1.20% potassium (Behera, 2018)**.** Some crop waste image shows in Fig no.1**.** As a result, crop waste management is the first and most vital subject that should be completed in order to maximize economic return while minimizing environmental impact.

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Vermicomposting is a technology that is eco-friendly, environmentally friendly, low energy, feasible and capable of converting crop waste into "Black Gold" (Nutrient rich manure). Epigeic species are suitable for vermicomposting due to their natural ability to feed organic waste, high reproduction rate and short life cycle (Dominguez, 2004). Vermicomposting species include *Eudrilus eugeniae*, *Eisenia fetida*, *Perionynx ceylanensis* and *Perionynx excavatus.* As a matter of fact, vermicomposting results in the bioconversion of bio waste materials into two useful products *i.e.*, earthworm biomass and worm compost.

Some crop wastes used in vermicomposting:

Paddy straw

Sugarcane trash

Banana waste

Wheat straw

Why vermicomposting?

- Helpful in recycling any organic wastes into valuable product.
- A eco-friendly, non-toxic product, environmentally safe and consumes low energy input while processing
- Good source of plant nutrient
- Improve crop growth, yield and quality
- Plant growth promoting substance
- Shortest time
- Cheapest

Steps during vermicomposting:

Collection of crop residues

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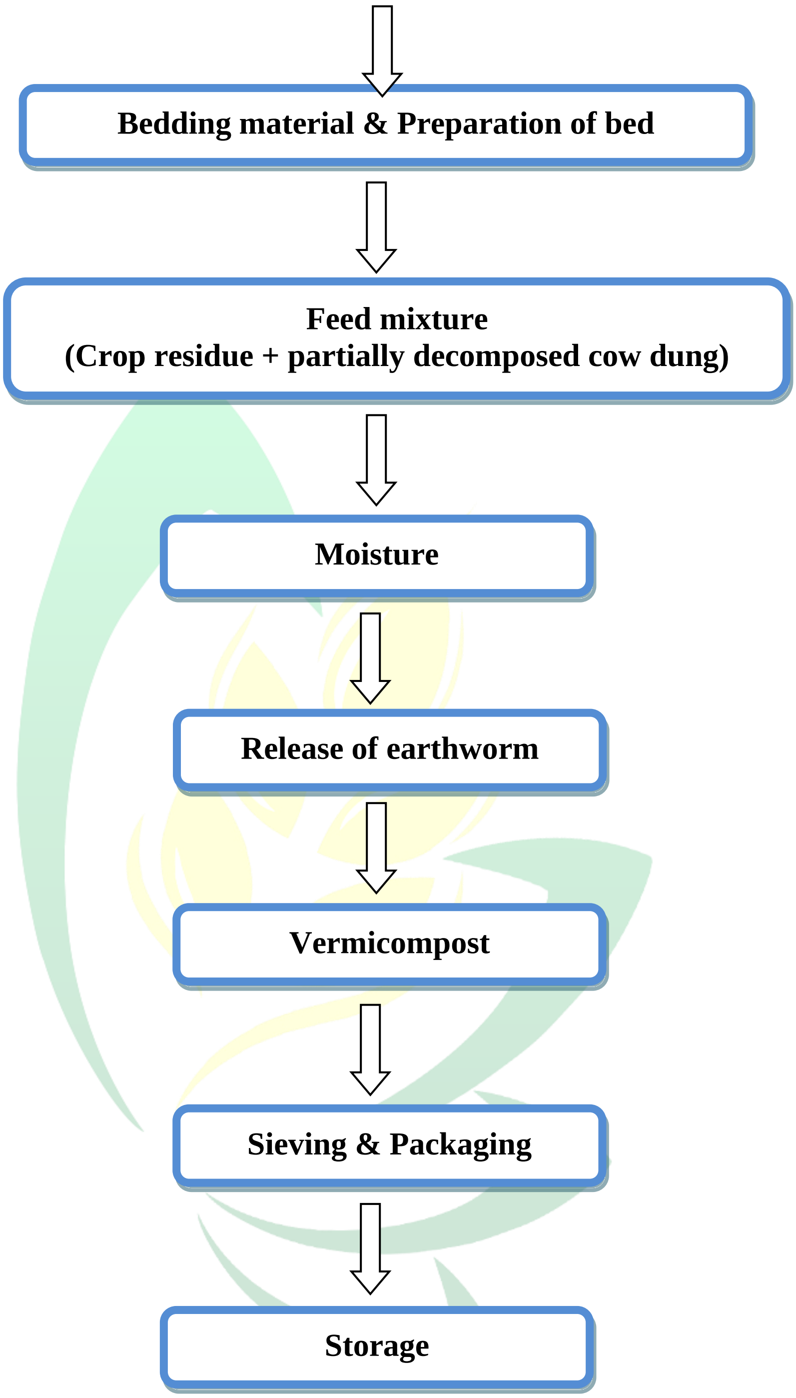
Processing of crop residues



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Precautions taken during vermicomposting:

- Only plant based organic material such as grass, leaves or vegetable peeling should be utilized in preparing vermicompost.
- Gliricidia looping and tobacco leaves are not suitable for rearing earthworm.
- Vermicompost heap should not be covered with plastic sheets.

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- Temperature should not be high (< 30 ˚c).
- Heaps should not be overloaded.
- Addition of higher qualities of acid rich substances should be avoided.
- The earthworm should be protected against birds, termites, ants and rats, moles and centipedes.
- Adequate moisture (70-80 %) should be maintained during the process. Either stagnant water or lack of moisture could kill the earthworms.
- After completion of the process, the vermicompost should be removed from the bed at regular intervals and replaced by fresh waste materials

Case study:

Chemical content:

Parmar *et al*. (2019) reported that vermicompost produced by *Eudrilus eugeniae* showed significantly higher nitrogen (1.246 %) and phosphorous (0.426 %) content in the treatment banana pseudostem + 5 % cow dung + anubhav biodegradable bacterial consortium followed by treatment maize fodder + 5 % cow dung + anubhav biodegradable bacterial consortium. They also reported that vermicompost of maize fodder waste has the lowest organic carbon (9.84 %) content while pH did not showed any variation due to treatment. Das *et al.* (2017) reported that vermicompost produced by *Eudrilus eugeniae* showed significantly higher nitrogen content (3.22 %) noted in treatment cow dung 50 % + banana pseudostem 50 % + rock phosphate while highest phosphorous content (2.42 %) in treatment cow dung 50 % + fish meal 25 %+ subabul leaves 25 % + rock phosphate and highest potassium content (0.73 %) found in the treatment cow dung 50 % + fish meal 50 % + rock phosphate and cow dung 50 % + subabul leaves 50 % + rock phosphate. Khobragade *et al.* (2017) noted that vermicompost produced from jowar straw showed better micronutrient (Iron, Manganese, Zinc and Copper) than the other crop residue used for vermicompost. Sharma (2017) enumerated that *Eisenia fetida* earthworm species used for vermicomposting showed lowest C: N ratio (9.4) was reported in forest residue. The significantly higher nitrogen (2.30 %), phosphorous (0.87 %) and sulphur (0.45 %) content were noted in vermicompost of legume residue while, potassium content (3.40 %) were found higher under banana residue. Borang *et al.* (2016) found that vermicompost produced by *Eisenia fetida* was showed significantly

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higher earthworm biomass was showed in vermicompost of paddy straw residue and highest nitrogen and phosphorous content was noted in vermicompost of soybean stover.

Biological content:

Parmar *et al*. (2019) reported that vermicompost produced by *Eudrilus Eugeniae* of banana pseudostem + 5 % cow dung + anubhav biodegradable bacterial consortium showed highest microbial count (1.4×10^{11}). Chaulagain *et al*. (2017) noted that highest bacterial (3.47×10^8 cfu/ml) and fungal count (1.93×10^6 cfu/ml) showed in vermicompost cow dung + banana pseudostem produced by earthworm species *Eisenia fetida*. Karmegam *et al.* (2012) found that highest bacterial (130.0 ± 3.3 cfu$\times10^6$/g), fungal (129.2 ± 2.6 cfu$\times10^3$/g) and actinomycetes count (79.7 ± 2.7 cfu$\times10^4$/g) was noted in vermicompost of leaf litter of *Polyalthia longifolia* + press mud (1:1).Nedunchezhiyan *et al*. (2011) found that highest bacterial count was noted in garden residue during 1 season and 2 season noted in sweet potato fresh leaves while highest fungal count showed in vermicompost of cassava dry leaves during 1 season and 2 season noted in sweet potato fresh leaves. They found that vermicompost of sweet potato fresh leaves showed highest actinomycetes count in 1 season and in 2 season noted that highest actinomycetes count in vermicompost of cassava dry leaves.

Physical content:

Kamalraj et al. (2017) found that normal compost (control) showed significantly lowest bulk density (0.61 g/cc), highest pore space (70.4 %) and highest water holding capacity (93.59 %) as compared to vermicompost prepared by *Eudrilus eugeniae* and *Perionyx excavatus* in different combinations of organic waste with cow dung. Wani *et al.* (2013) reported highest moisture content (3.1 ± 0.08) showed in vermicompost of kitchen waste.

Conclusion:

- Vermicomposting has been shown to be a more environmentally friendly technology and should be preferred in developing countries for sustainable agro-waste management and nutrient recovery from farm and agricultural wastes such as sugarcane, paddy, maize, wheat, banana, mixed farm waste and so on.
- It provides powerful tool for developing strategies that lead to a more efficient process for the disposal and/or management of farm waste into wealth.

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