Production Technology and Edaphological Anticipations of a Promising Soil Amendment: Vermicompost

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Abstract**—** *Vermicompost, an enriched compost made by involving earthworms in the preparation process, is one of the most important products in sustainable agriculture today. It has the potential to promote significantly more plant growth than other composts, prevent soil degradation, remediate it, and naturally improve overall soil health and quality. It provides cultivators with numerous opportunities, not only in terms of social and economic advancement, but also for maintaining and increasing the productivity potential of agricultural land. The dynamic nutritional composition and soil-enhancing properties of vermicompost are unmatched by any other available alternative.*

Keywords— Black gold, earthworms, soil health, vermicomposting bed and vermicompost.

I. INTRODUCTION

Composting is a viable method for converting biodegradable solid wastes into beneficial organic soil amendments for environmentally friendly agricultural production systems. Earthworms are known as ecological engineers and farmers' best friends because they help to promote the composting process, improve nutrient value, and speed up the formation of stable organic end products. Vermicomposting involves using earthworms to create enriched compost, and the finished product is known as vermicompost. Earthworms contribute to the decomposition process in three ways: physically by serving as an aerator, crusher, and mixer; by chemical means as a degrader; and biologically as a stimulator. Earthworms feed on biomass (organic matter which is in the process of decaying) and excrete in digested form as worm casts/ worm manure.

II. SUITABLE EARTHWORM SPECIES

Earthworms that live on the surface are frequently used in vermicomposting, namely *Eisenia fetida* (redworm) and *Eudrilus eugeniae* (African nightcrawler). They can convert a wide range of biodegradable waste into worm casts or worm manure, also known as "black gold," and are highly engaged in the reproduction process and effective in organic material recycling

PIC 1©: *Eisenia fetida* (redworm), a popular choice among vermicompost cultivators.

III. REQUIRED MATERIALS FOR VERMICOMPOSTING

a. A Cement pit or portable vermicomposting bed (made of silpaulin) of dimensions of 12×4×2 feet.

b. Approximately 750-800 kg of cattle manure, at least 1-1.5 months old (pre-digested).

200-250 kg of dry matter and shredded pre-digested organic waste. Fresh green waste has a considerable nitrogen content and is susceptible to overheating compost thus, pre-digested waste is encouraged. The ratio of dry matter (high carbon content) to organic waste (high nitrogen content) ought to equal 3:1.

TABLE 1
RECOMMENDED CARBON-RICH DRY MATTER & NITROGEN-RICH ORGANIC WASTES.

Dry matter	Organic wastes
Peat moss	Chopped green vegetable peels/ waste
Shreds of newspaper	Sawdust
Corrugated cardboards	Softwood chips (Fine)
Shrub trimmings	Shredded barks of softwood

Source: Chanu et al. (2018).

c. Since paddy straw has a C:N ratio of 150:48, or nearly 3:1, it can be used as both dry matter and organic waste. One should also refrain from using diseased plants and pungent kitchen wastes like onions, garlic, eggshells, etc. because earthworms are unable to consume these things and the quality of the finished product will suffer.

d. Approximately 800-815 earthworms (350-360 worms/m^3 of bed or pit volume).

e. A shovel and/or similar garden tool, along with a sieving net.

PIC 2©: Portable silpaulin vermicomposting bed.

IV. SITE OF PREFERENCE

Vermicomposting can be carried out anywhere that features shade, a high humidity level, and a cool climate. Cattle sheds, unused buildings, and open areas with artificial shading are all possible locations.

V. METHODOLOGY

After installing or erecting a vermicomposting bed or pit in a desired location, fill it with the following cross-section of its content and release earthworms at its upper surface as they eventually make their way inside.

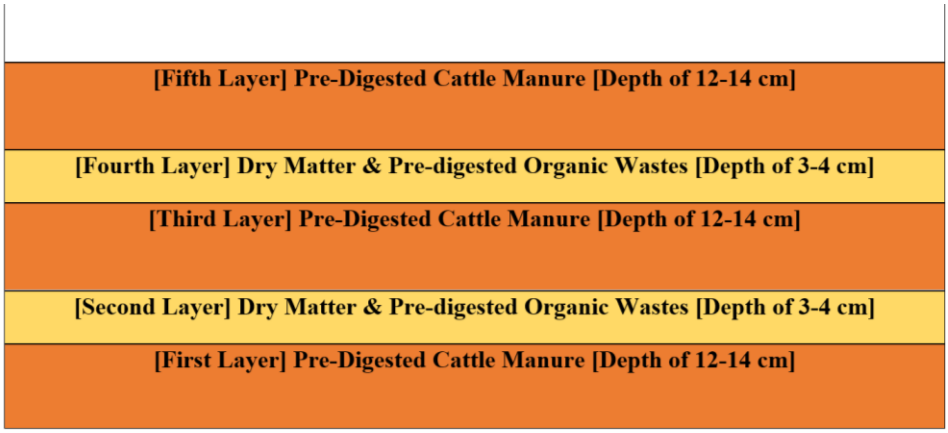

FIGURE 1©: Cross-section of the make-up of pre-digested (at least one month old) cattle manure, dry matter(s), and/or pre-digested organic wastes inside vermicomposting bed/pit. ***Source: Author's own depiction of cross-section of vermicomposting bed.***

PIC. 3©, 4© & 5© (Top left, top right & bottom): Application of cattle manure at the bottom of the bed after its installation, application of dry matter (sawdust) above the bottom layer of cattle manure, & application of earthworms over the bed.

VI. MANAGEMENT

a. Cover the top portion of the bag or pit using jute bags or paddy straws to avoid predatory creatures like birds from eating the earthworms.

b. Throughout the composting period, regular watering, turning, and subsequent monitoring are recommended to maintain the suggested percentages of moisture (around 60%) and temperature (18 ^{0}C- 35 ^{0}C).

c. Moisture content can be manually determined by placing a small amount of vermicompost in your own palm; it should adhere to your palm but not drip liquid over your fingers.

d. To ensure adequate air circulation and decomposition, the material inside the bag or pit should be turned upside down once every 18 to 20 days with a shovel or a similar tool.

PIC 6©: Turning of vermibed contents (Upside down).

VII. HARVESTING & STORAGE

a. The final product (vermicompost) accounts for approximately 75% of the initial input.

b. Depending on management, vermicompost would be ready in 75 to 90 days on average.

c. The final product would be made up of tiny granular fragments similar to tea granules, would not smell bad, and would have a dark brownish-black colour.

d. Watering should be stopped a week prior to the anticipated harvest date.

e. Before harvesting, manually check the moisture content of vermicompost by placing some of it in your palm; it should stick to the palm of your hands but not drip any water.

f. To make certain that only a tiny percentage of earthworms perish during the compost harvest, use the sieving net gently.

g. The harvested vermicompost must be stored in a cool, dark place that is not exposed to direct sunlight.

h. If moisture is maintained at 40%, vermicompost could be stored for an entire year without losing quality.

PIC 7©: Harvesting of vermicompost (by manual means) using sieving net.

VIII. VERMICOMPOST: A MEANS FOR IMPROVING SOIL HEALTH AND ENHANCING CROP PRODUCTIVITY

Vermicompost contains a substantial amount of pathogenic microbe-inhibiting agents, useful soil microbial flora, and essential plant nutrients. As a result, the organic by-products produced by earthworms inherit the majority of black gold's advantageous characteristics. When used as an organic soil amendment, vermicompost enhances soil quality by improving its chemical, physical, and biological properties. It also has earthworm cocoons, which increase earthworm activity and population growth in the soil. It reduces nutrient losses and increases the efficiency of chemical fertilisers. Vermicompost reduces pests and

diseases, accelerates the decomposition of organic material in the soil, is void of pathogens, toxic substances, weed seeds, and other contaminants, and incorporates beneficial vitamins, enzymes, and hormones such as auxins and gibberellins.

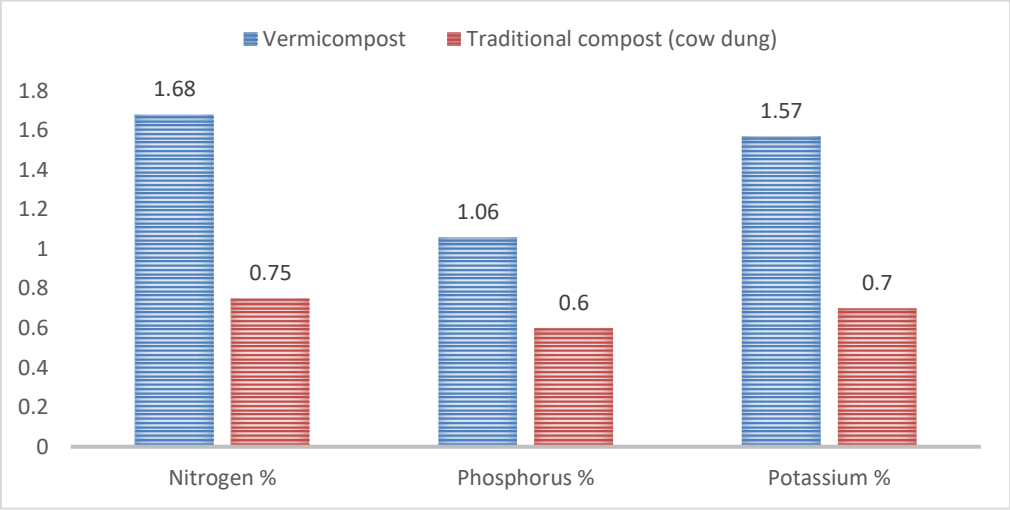

FIGURE 2: Comparison of contents of primary nutrients (N, P, K) in vermicompost & traditional compost (cow dung).

Source: Author's own graphical depiction.

In plant nurseries, vermicompost outperforms other synthetically grown media. It can be used in nurseries as a rooting medium and to establish saplings, and it has excellent impacts on plant growth in general, promoting the formation of new shoots and leaves and improving the quality and shelf life of the produce. It preserves the quality of the produce while improving its taste, lustre, and appearance. Immobilized enzymes such as protease, lipase, amylase, cellulase, and chitinase in vermicompost continue to break down agricultural residues in the soil itself. It does not smell bad, unlike traditional manure and decomposing organic waste. Vermicompost is becoming more popular as a key component of the organic farming system due to its excellent nutritional value as well as its effectiveness as an environmentally friendly soil amendment.

TABLE 2

AVERAGE NUTRITIVE VALUE OF VERMICOMPOST.

Nutrient	Content
Organic Carbon (OC)	9.15- 17.98%
Nitrogen (N)	1.5- 2.1%
Phosphorus (P) & Potassium (K)	1.0- 1.5% & 0.6%
Calcium (Ca) & Magnesium (Mg)	22.0-70.0 meq/ 100g
Sulphur (S) & Copper (Cu)	128- 548 ppm & 100 ppm
Iron (Fe) & Zinc (Zn)	1800 ppm & 50 ppm

Source: Chanu et al. (2018).

Application of vermicompost for different crops: The type of crop grown in the field or nursery determines how much vermicompost is applied. Vermicompost should be used as part of integrated nutrient management systems to improve crop production. The recommended amount of vermicompost after transplanting and last ploughing for major field crops like rice and maize is 2.5 tons/ha; for oilseeds and pulses, it is between 2.5 and 4.5 tons/ha; and in case with the vegetables, it is roughly 3-3.5 tons/ha.

IX. LIMITATIONS

It is to be noted that vermicompost, despite being a dynamic and diverse compost, has limitations, primarily due to its inability to compete individually over the primary nutrients (nitrogen, phosphorus, and potassium) of industrially produced fertilizers, such as urea (46% nitrogen), diammonium phosphate (18% nitrogen and 46% phosphorus) and muriate of potash (60 % potassium), which far outweighs the N, P, K composition of vermicompost.

X. CONCLUSION

Vermicompost has the potential to transform conventional agriculture into a more sustainable form of farming, and it should be used as a part of integrated nutrient management to increase crop productivity rather than relying solely on it, as it cannot supplement the requirements of conventional fertilizers but can work in conjunction with them, thus leading to a prolonged retention of soil quality and health.

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