Review Article

Vermiwash: A Potential tool for crop production in organic agriculture

ABSTRACT

In India, the first green revolution enormously enhanced crop production, but on the other hand, massive application of chemical fertilizers and pesticides over a period has resulted in poor soil health, pesticide toxicity, heavy disease and pest incidences, and environmental pollution. Scientists and policy planners are, therefore, reassessing agricultural practices which relied more on biological inputs rather than heavy usage of chemical fertilizers and pesticides. Organic farming can provide quality food without adversely affecting soil health and the environment. Vermiwash is emerging as an important potential tool for the promotion of organic agriculture.

Vermiwash is a brown coloured, odorless, liquid extract produced from vermicompost in a medium where earthworms are richly populated. It contains mucus, excretory products of worms, and various concentrations of macro, micro, and beneficial nutrients along with beneficial microorganisms, growth hormones, vitamins, enzymes, and amino acids, therefore is a good source for plant nutrition used as foliar spray in sustainable agriculture.

Keywords: Vermiwash, vermicompost, potential tool, vermiculture, organic agriculture

1. Introduction

Conversion of biodegradable waste into enriched compost is possible through the technology known as vermicomposting. Earthworms consume raw materials and excrete it in a digested form called worm cast which is rich in nutrients, growth promoting substances, beneficial soil microflora, *etc*. (Das *et al*., 2014). Accumulation of wastes is a serious problem which needs to be managed to make environment free from pollution. Vermiwash helps to manage market wastes in a profitable manner. Vermiwash is an eco-friendly liquid organic fertilizer obtained from units of vermiculture/vermicompost in the form of drainage. The vermiwash is formed due to the movement of water in the vermicompost unit from the increased moisture content due to the heat generated during the vermicompost process. This water absorbs the earthworm body secretions, enzymes, plant growth hormones, and other nutrients from the organic waste to form the vermiwash which can be easily absorbed by plants (Sundaravadivelan *et al*., 2011). Presently, in organic farming systems, vermiwash plays a key potential for sustainable crop production. This vermiwash contains enzymes, secreted from earthworms which would stimulate the growth and yield of agricultural crops and even develop resistance in crops. Vermiwash also contains the soluble plant nutrients

apart from some organic acids and mucus of earthworms and microbes (Sundararasu, 2016). It is a very good plant tonic which can be used for foliar spray. There is no special device required to collect the vermiwash except for a tap which is fitted at the bottom of the containers where earthworms are cultured. Even during the period of normal management of the vermiculture, water is sprayed regularly to maintain adequate moisture and excess water is drained which contains some essential plant nutrients. The composition of vermicompost and vermiwash prepared from the same organic matter are essentially the same (Gudeta *et al*., 2021). Vermiwash plays an important role in plant growth and development, contribute to the initiation of rooting, root growth, enhancement of crop production, improvement in soil organic matter and facilitat nutrient availability to crops, resulting in good crop yield. Vermiwash can be used for crop production as both foliar spary and soil application. Presently, foliar application is the current trend of sustainable crop production to fulfill the target of production with a low quantity of manure (Rajasooriya and Karunarathna, 2020). It was found that spraying vermiwash on vegetables markedly improved both the quality and quantity of the yield (Sundararasu, 2016). Further, its production cost is less expensive as compared to chemical fertilizer and very ease to produce. Besides its application as organic fertilizer to enhance crop productivity, it can also be applied in disease suppression and pest control due to the presence of essential antimicrobial and anti-pest chemicals (Kanchan *et al.*, 2013; Thakur and Sood, 2019).

2. Vermiwash and its composition

Vermiwash is a brown colored, odorless, liquid extract and a by-products parts of vermiculture/vermicompost in the form of drainage that is collected after the channel of water through a column of worm action of vermiculture and vermicomposting and is very beneficial as a foliar spray (Jaysawal *et al.*. 2020). It is a worm coelomic fluid extract containing several enzymes (cocktails of *proteases*, *amylases*, *urease* and *phosphatase*), plant growth hormones (cytokinin, auxin), vitamins, amino acids, macro and micronutrients (Nayak *et al.*, 2019) along with excretory substances and mucus secretion of earthworms, therefore is a good source for plant nutrition.

It contains total solids (2448 mg/L), volatile solids (738 mg/L), silica (8 mg/L), auxin (0.98 µg/L) and cytokinin (0.68 µg/L) (Patil *et al*., 2007). Microbial study of vermiwash found the presence of many useful micro-organisms such as heterotrophic fungi, actinomycetes, bacteria including nitrogen-fixing bacteria like *Azotobacter* spp.,

Agrobacterium spp., and *Rhizobium* spp. and phosphate solubiliing bacteria (Zambare *et al*., 2008). The nutrient composition of vermiwash is presented Table 1 (Nayak *et al.*, 2019).

Table 1. Nutrient analysis of vermiwash

Sl. No.	Parameters	Value
1	pH	7.39-7.5
2	EC	0.008±0.001
3	Organic carbon	0.25 ± 0.03%
4	Nitrogen	0.01-0.001%
5	Phosphorus	1.70%
6	Potassium	26 ppm
7	Sodium	8 ppm
8	Calcium	3 ppm
9	Copper	0.01 ppm
10	Iron	0.06 ppm
11	Mangnesium	160 ppm
12	Manganese	0.60 ppm
13	Zinc	0.02 ppm
14	Total heterotrophs (cfu/ml)	1.79×10^3
15	Nitrosomonas (cfu/ml)	1.01×10^3
16	Nitrobacter (cfu/ml)	1.12×10^3
17	Total fungi (cfu/ml)	1.46×10^3

3. **Vermiwash preparation**

Vermiwash is the liquid extracted from vermicompost, which is prepared by feeding earthworms with raw materials like leaf litter or cow dung or other organic materials. Two exotic species *Eisenia fetida* and *Eudrilus eugeniae* are widely used in India for production of vermicompost/vermiwash.

The vermipits were prepared with (2m x1m x0.75m) (length x breadth x height) with the arrangement of layers performed from bottom to top as shown in fig. 1. The pebbles or coconut shell filled on the bottom layer to absorb excess water from the composting pit. The second layer filled with sandy soil to prevent the accumulation of extra water in the medium and the third layer contained organic soil and old compost inoculated with earthworms. Cow dung and leaf litter blended at the ratio of 1:2 and added to the pit in the fourth layer. Finally, on the top layer, the gunny bags spread on the top of the pit to prevent direct sunlight and keep the medium moist enough. The contents of the pit turned once in 2 or 3 days to enhance aeration in the course of vermicomposting. After 30 days of the composting process, vermiwash started to collect at the bottom of the vermicompost pit. The water that passes through the vermiculture/vermicompost, resulting in washing of the live and dead earthworms, soil microorganisms and decomposed organic matter, carries all these dissolved

substances. As the water can dissolve some vermi casts which contains lots of nutrients, they find their way into vermiwash.

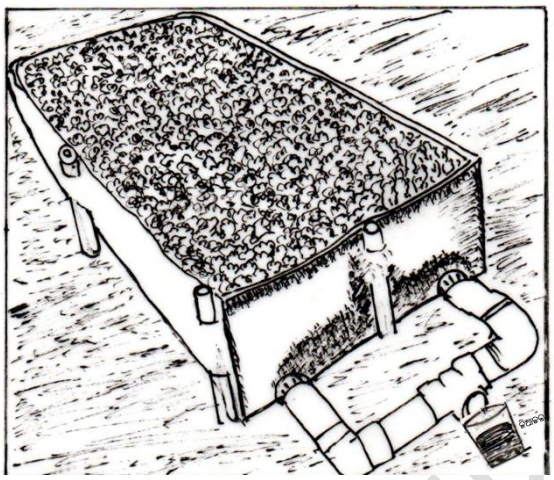

Fig 1: Model of vermicompost pit

3.2 Setting up of a vermiwash unit for commercial production

(ECO – SCIENCE research foundation method)

Vermiwash units can be set up either in barrels or in buckets or even in small earthen pots. The procedure explained here was standardised by Ismail (1997).

Materials needed

- A plastic barrel (250 lt) or small bucket
- broken stones
- coarse sand
- garden soil
- earthworms
- cattle dung
- straw and
- water

Fig 2: Vermiwash unit (in buckets) for commercial production

Production process

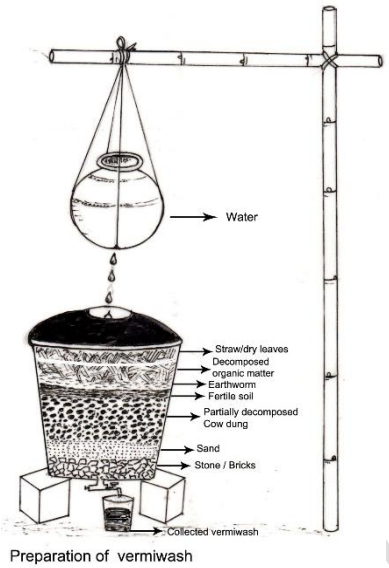

Fig 3: Vermiwash unit (in small earthen pots) for commercial production

The empty plastic barrel with one side open is taken and the base of the barrel is fitted with a tap to collect vermiwash. The barrel is filled with different successive layers (Fig. 2). First base layer is filled with medium sized bricks or stones up to a height of 10-15 cm or 10-15% of the container. Above the base layer, a layer of coarse sand (up to 6 inches) and fine sand (5 inches) are spread. After that, a layer of partially decomposed cow dung (20-25 cm) is filled. Introduce of 1000 -1500 juvenile or adult earthworms (*Eisenia foetida / Eudrilus eugeniae*) with fertile soil into the container. Then decomposed organic residues of 40-45 cm of the container were loosely placed in the plastic barrel. On the top layer dry leaves, straw, etc were placed as additional raw material that mainly prevents direct exposure from sunlight. All the layers in the container is moistened by sprinkling water. Container is sprinkled with approximately 2 lit of water per day. After 16 to 20 days vermiwash will be produced in the barrel. Every day about 3-4 lit of vermiwash will be collected from this unit. Hang one pot with a bottom hole over the plastic barrel in a way so that waterfall drops by drop. Every day 4-5lt of water is poured into the hanging pot. Keep another pot under the tap and collect 3-4lt of vermiwash every day. The tap of the unit is opened the next day morning and the vermiwash is collected. The entire setup may be emptied and reset between 10 and 12 months of use. The collected vermiwash must be stored in a cool and dry place. For a nutrient supplement, vermiwash (1:10) i.e @ 1 litre is generally mixed with 10 litres of water and the solution is sprayed on entire parts of the growing crops. However, to control various pest and diseases of crop, vermiwash @ 1 litre thoroughly mixed with 1 litre of cow urine and 10 liters of water and is kept overnight and sprayed on the affected crops (Nayak *et al.*, 2019).

4. Application methods of vermiwash

Vermiwash alone or mixed with cow urine (One liter vermiwash + one liter cow urine+ eight liters water) is also an excellent growth promoter. Before the application of vermiwash as foliar application on any plants, it should be diluted with water (10 percent). Das *et al*, 2014 reported that before transplanting, seedlings are dipped in vermiwash solution for about half an hour after diluting it with water (5 times). When vermiwash liquid is added to compost pits, it enhances the degradation process.

5. Benefits of vermiwash

Being an excellent nutrient supplement, it enhances soil the physico-chemical properties and maintains soil fertility in a long run. It improves soil aeration, soil tilth and texture thereby reducing the compaction. It also enhances water holding capacity of soil and improves soil fertility status. It can also be added in the compost pit to hasten the degradation process. Vermiwash is known to play a major role in the plant growth and development, contribute to root initiation, root growth, plant development, promotion of growth rate and improvement in crop production, increases nutrient uptake by crops resulting in good crop yield (Nayak *et al*., 2019). Besides serving as a plant growth promoter, vermiwash has tremendous biopesticide properties. It is highly toxic against insect-pest survival and increases the disease resistance power of the crop (Sayyad, 2017). Now a days, it is being popularised as liquid manure. It increases the rate of photo synthesis in crops/plants. It also increases the number of micro-organisms in the soil which helps in decomposing soil organic matter (Tripathi *et al*., 2005).

6. Effect of vermiwash on plant growth and yield

It was found that foliar spray of vermiwash significantly increased the growth and yield parameters of brinjal (Sundararasu and Jeyasankar, 2014). Verma *et al.*, 2017 reported that application of 100% RDF along with vermiwash @100 lt ha^{-1} produced distinctly higher plant height, number of primary and secondary branches, leaf area index and dry matter accumulation. The plant height, leaf area index, pod length and girth, fresh weight of the pods, 100 seed weight and yield per plant of greengram were recorded highest due to application of 50% RDF along with foliar spray of vermiwash @75% (Rajasooriya and Karunarathna 2020). Yassen, 2020 reported that the growth parameters of lettuce were significantly higher due to application of vermicompost @ 4t/ha with foliar spray of vermiwash @ 150 ml/lit .

It was found that application of vermiwash at Low concentration is effective in bringing about seed germination and vigour seedling growth (Fathima and Sekar, 2014). This could be attributed due to presence of nutrients and growth promoting substances in vermiwash which showed its potentiality in seed germination and seedling vigour (Chattopadhyay, 2015).

7. Effect of vermiwash on soil properties

Vermiwash contains micro and macro nutrients, hormones which promote plant growth and yield and improves soil fertility status (Sharma *et al*., 2005). Use of Organic formulations in agriculture could be a dynamic source to move forward soil fertility (Verma *et al.,* 2017). Combination of vermicompost and vermiwash recorded a significant influence on the biochemical characteristics of the soil with marked improvement in soil micronutrients and better qualitative improvement in the physical and chemical properties of the soil (Nayak *et al*., 2019). Tripathi *et al.* (2005) suggested that vermiwash increases the number of microorganisms in the soil which helps in the decomposition of organic matter.

Sundararasu and Jeyasankar, 2014 reported that application of vermiwash significantly increases the macro and micro nutrient status of soil.

8. Conclusion

Vermiwash seems to possess an inherent property acts not only as a liquid organic biofertilizer which promot growth and yield of plants but also acts as a mild biopesticide. So, it can be used as a potent input in organic farming and sustainable crop production for both soil health and insect, pest and disease management. Vermiwash is now effectively used in organic agriculture for both soil health and disease management for sustainable crop production and to prevent environment and human health.

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