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Vermiwash: A potential tool for sustainable agriculture

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Abstract

During first green revolution, excess use of agrochemicals adversely affects natural resources and ecosystem. Therefore we must have to go for sustainable agriculture to conserve and protect our resources and ecosystem. For this vermiwash is emerging as important potential tool. Vermiwash is a brown coloured, odourless, liquid biofertilizer, which is collected after passes via column of worm culture. It is considered as storehouse of nutrients and microorganisms, used as foliar spray for crops. Vermiwash contains mucus, excretory products of worms and various concentration of macro, micro and beneficial nutrients along with beneficial microorganism, growth hormones, Vitamines, enzymes and amino acids, therefore is a good source for plant nutrition in sustainable agriculture.

Keywords: Potential tool, green revolution, sustainable agriculture

1. Introduction

In India, the first green revolution enormously enhanced the crop production, but on the other hand, massive Application of chemical fertilizers over a period has resulted in poor soil health, reduction on agricultural produces, and increases in incidences of insect pest and disease and environmental pollution (Ansari and Ismail, 2001) ^[1], and long term use of various agrochemicals like fertilizers, plant growth promoters, pesticides and improved seed varieties, adversely affected ecosystems like soil, water, and food contamination and gene pool of wild seeds. The second green revolution started with organic farming (Sathe 2004, Sharma 2004) ^[28, 30]. But for feeding the vast increasing population of our nation, immediately we cannot completely shifted towards organic farming. Keeping this view in mind we have to go for sustainable crop production. The aim of sustainable agriculture is to fulfill our present needs (food, shelter and clothes) without compromising the ability of future generations to meet their own needs. Therefore three main objectives of sustainable agriculture is: a healthy environment, economic profitability, and social and economic equity, and for achieving these objectives application of vermiwash can play a important role in ensuring a sustainable agricultural system. Vermin wash is a liquid organic fertilizer obtained from units of vermiculture/vermicompost in the form of drainage. 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 quality of vermiwash produced by earthworms depends on the vermicompost means source of feeding material that is used (Sreenivas 2000) ^[31]. Vermiwash, generally applied as a foliar spray act as replacement and supplement for agrochemicals and for their unique capacity to provide nutrients effectively and quickly.

1.1 Vermiwash and its composition

Vermiwash is a honey brown coloured liquid extract of organic composts, generally the wash of earthworms Present in the medium collected after the passage of water through the different layers of worm culture unit (Jayabhaye and Bhalerao, 2015) ^[14] from the increased moisture content due to heat generated during vermicompost. It is a worm coelomic fluid extract containing several enzymes, plant growth hormones (IAA, Cytokinin, G A₃), Vitamins, macro

and micro nutrients (Bucker field *et al.*, 1999) ^[5] along with excretory substances and mucus secretion of earthworms (Ansari and Sukhraj, 2010) ^[2], humic acid from soil and organic waste materials which can be easily absorbed by plant tissues (Sundaravadivelu *et al.*, 2011; Nath and Singh, 2012) ^[32, 22]. 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) ^[26]. Dead earthworm's tissue releases nitrogen in form of nitrates-25%, ammonia 45%, organic soluble compound 3% and uncalculated material 27% which improves the nutrient quality of vermiwash. Nitrogen in vermiwash is present in the form of mucus, enzymes, nitrogenous excretory substances of worms and plant growth hormones (Tripathi and Bhardwaj, 2004). Vermiwash is rich in various enzymes cocktail of protease, amylase, urease and phosphatase and also microbial study of vermiwash found the presence of nitrogen fixing bacteria like *Azotobacter sp.*, *Agrobacterium sp.*, and *Rhizobium sp.*, and some phosphate solubilising bacteria (Zambare *et al.*, 2008) ^[39]. Vermiwash formed from municipal solid wastes is composed of organic matter, plant nutrient and soluble salt which increases soil nutrient and moisture content (Sayyad, 2017) ^[29].

Table 1: Nutrient analysis of vermiwash (Source: <http://www.erfindia.org/vermiwash.asp>)

Parameters	Content
pH	7.39-7.5
EC	0.008±0.001
Organic carbon	0.25 ± 0.03%
Nitrogen	0.01-0.001%
Phosphorus	1.70%
Potassium	26 ppm
Sodium	8 ppm
Calcium	3 ppm
Copper	0.01 ppm
Iron	0.06 ppm
Magnesium	160 ppm
Manganese	0.60 ppm
Zinc	0.02 ppm
Total heterotrophs (cfu/ml)	1.79×10^3
Nitrosomonas (cfu/ml)	1.01×10^3
Nitrobacter (cfu/ml)	1.12×10^3
Total fungi (cfu/ml)	1.46×10^3

1.2 Vermiwash preparation

Vermiwash may be collected from the vermicompost units as a byproduct liquid extract.

Whereas other method (Kale, 1998) ^[16] of Vermiwash preparation is followed by taking One kg adult earthworms (approximately 1000 worms) of the same species (*E. euginiae*) were collected and without any mixing of the casts, they were released into a 500 ml of lukewarm distilled water (37 °C - 40 °C) and agitated for two minutes. Earthworms were taken out and again washed in another 500 ml at room temperature (+30 °C) and released back into the tanks. The agitation in lukewarm water made the earthworms to release sufficient quantities of mucus and body fluids. This is known as true vermiwash. Transferring into ordinary water was to wash the mucus sticking still on to their body surface and this also helped the earthworms to revive from the shock.

Another method for the preparation of vermiwash, a plastic container of 15 to 20 liters capacity is required and the base of the container is fitted with tap to collect the watery worm extract. The container is filled with different successive layers. First base layer, medium sized bricks or stones up to a height

of 10-15 cm filled. Above the base layer a layer of coarse sand (up to 6 inches) and fine sand (5 inches) are spread. Introduction of locally available earthworms (*Eisenia foetida*) mixing with fertile soil applied. After that, a layer of partially decomposed cow dung (20-25 cm) and organic residues of 40-45 cm were poured. All the layers in the container is moistened by sprinkling water over it. Container is sprinkled with approx 2 L water per day. After 16 to 20 days preparation of vermiwash in the unit begins. Everyday about 1-2 L of vermiwash will be collected.

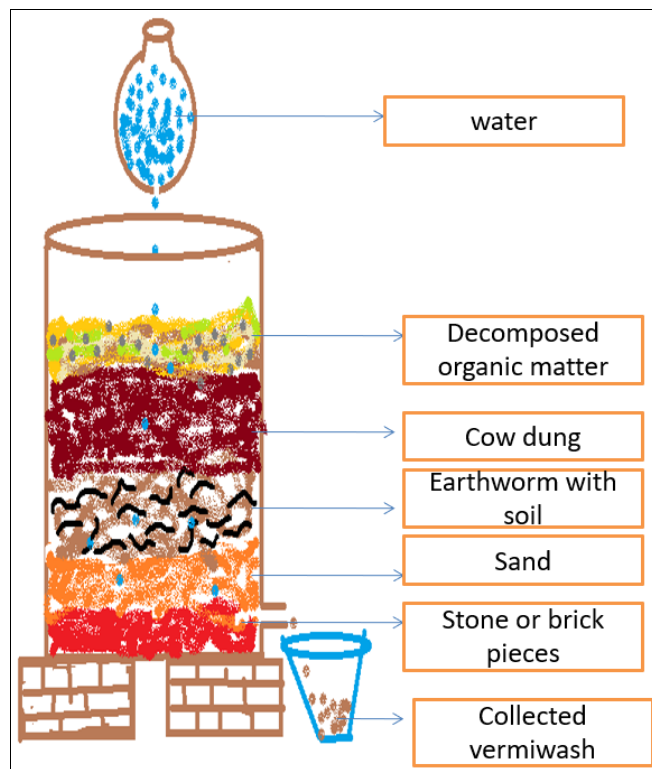


Fig 1: Preparation of vermiwash

For nutrient supplement, vermiwash (1:10) i.e @ 1 litre is generally mixed with 7-10 litres of water and the solution is sprayed on leaves of the growing crop at the evening. However, to control various pest and diseases, 1 litre of vermiwash is thoroughly mixed with 1 litre of cow urine and 10 liters of water and is kept overnight before spraying.

1.3 Uses of vermiwash

Vermiwash is a liquid organic fertilizer prepared from biodegradable organic wastes used both as replacement and supplement of solids and for their novel capacity to provide nutrient effectively and quickly (Fathima and Sekar, 2014) ^[10]. Being an excellent nutrient supplement, it enhances soil physico-chemical properties and maintains soil fertility in 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 nutrient status of both macro and micro nutrients. 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 growth rate and improvement in crop production and improved nutrient uptake by crop and enhance nutrient content which are readily available for the plants, resulting in good crop yield (Sundararasu and Jeyasankar, 2014). Besides serving as a plant growth promoter vermiwash

has tremendous biopesticide properties. It is highly toxic against insect-pest survival (Sayyad, 2017) ^[29] and it increases disease resistance power of the crop (Yadav *et al.*, 2015). It is reported that mycelial growth of pathogenic fungi was inhibited at 20-30% dilution. It acts as biopesticide when it is sprayed along with 10% cow urine or neem/garlic extracts. Now a days it is also being Popularised as liquid manure.

1.4 Effect of vermiwash on plant growth and yield

Vermiwash is a wonderful tonic from 'farmer's friends' for boosting plant growth and yield safely, ecofriendly and economically. Sudararasu and Jeyasankar (2014) observed that vermiwash spray enhanced growth (plant height and number of leaves) and yield (number of flowers and fruits per plant) parameters when applied to brinjal plant. Nath *et al.* (2009) ^[11] also reported that vermiwash produced from animal wastes, agro/kitchen wastes increased plant growth, flowering and productivity. Application of 100% RDF + vermiwash @ 100 l ha⁻¹ produced distinctly higher plant height, number of primary branches, number of secondary branches, leaf area index and dry matter accumulation (Verma *et al.*, 2017) ^[36]. It is reported that Low concentration of vermiwash is effective in bringing about seed germination and seedling growth (Fathima and Sekar, 2014) ^[10]. This could be attributed to presence of nutrients and growth promoting substances in vermiwash which showed its potentiality in seed germination and seedling vigour (Chattopadhyay, 2015) ^[7]. Kale (1998) ^[17] noticed increased growth and yield response of *Anthurium* with the foliar application vermiwash. The seedlings of *Vigna mungo*, *Vigna radiate* and *Sesamum indicum* resulted in increase of growth parameters such as the root length, shoot length, number of twigs and leaves and total biomass of the plant after spraying the vermiwash of *Perionyx excavates* (Hatti *et al.*, 2010) ^[12]. Kumar *et al.* (2013) ^[19] found that application of vermiwash enhanced plant height and number of leaves (56.29 cm and 6.14 days at 45 days after bud emergence), spike length and rachis (90.68 cm and 47.07 cm), number of florets (15.08), vase-life (10.02 day) number of corms m⁻² (28.66), weight of corms (50.68 g) and number of cormels plant⁻¹ (56.66). The treatment was also effective in reducing number of days taken to spike emergence (81.73 day). Application of vermiwash along with vermicompost also resulted in enhanced growth of plant parameters such as number of leaves, leaf length, plant height and root length to higher level (Tharmaraj *et al.*, 2011) ^[33]. Hidlago *et al.* (2006) ^[13] reported that the incorporation of earthworm increased plant growth, leaf growth and root length. Karuna *et al.* (1999) ^[18] had studied on two different concentrations of vermiwash of *Eudrilus eugeniae* which sprayed on anthuriums and found that the most effective percentage of vermiwash to be used was 50 percent which is good in inducing vegetative growth such as number of suckers, length, breadth of leaves, length of petiole and develop early flowering in plants. Vermiwash exhibited growth promoting effects on the ecomorphological characters such as plant height, length and diameter of the internode, number of leaves, leaf surface area, root length, wet and dry weight of the shoot and root of *Abelmoschus esculentus*. Vermicompost and vermiwash are also enriched in certain metabolites and vitamins that belong to the B group or provitamin D which also help to enhance plant growth (Lalitha *et al.*, 2000) ^[20]. Ansari and Sukhraj (2010) ^[2] reported combination of vermicopost and vermiwash enhanced the percentage of fats and proteins in okra. The biochemical qualities of the fruits grown in

vermiwash and vermincompost indicated higher nutrient quality, which may be attributed to the presence of plant growth promoters like gibberellins, cytokinins and auxins (Ansari and Sukhraj, 2010) ^[2]. Similarly, Edwards *et al.* (2004) ^[8] has also observed increase in quality of fruit with the application of vermiwash.

1.5 Effect of vermiwash on insect pest and diseases

Vermiwash proves to have excellent bio pesticidal activities since, the plants treated with vermiwash were disease resistant and no any worms like leaf eaters were seen on the leaves and other parts of plants (Samadhiya *et al.* 2013) ^[27]. Vermiwash serves as pesticide, disease curative and crop tonic and increase the yield of lab lab beans (Esakkiammal *et al.*, 2015) ^[9]. Plants treated with vermiwash are green having vigorous growth and much more resistant to pests and disease and also (Jayashree, 2006). ^[15] Mishra *et al.* (2014) ^[22] concluded that vermiwash when applied with bio-pesticide is a preferable option for the growth, productivity as well as management of *Lucinodes orbanalis* infestation on brinjal crop. Mishra *et al.* (2015) ^[23] noticed that combination of vermiwash and biopesticide is a superior alternative of the chemical fertilizer and pesticides for the management of *Leptocorisa varicornis* as well as productivity of rice crop. Since vermiwash is mild biopesticides, the combination showed synergistic effect in controlling the *Leptocorisa varicornis* population which ultimately enhances the productivity. Sayyad (2017) ^[29] reported that increasing concentration of vermiwash suppressed insect-pest population of tomato. Balam (2002) ^[4] studied bio pesticidal properties of vermiwash produced using cowdung and vegetable wastes by inoculating earthworm species (*E. foetida*) in the laboratory to determine the effect of using the vermiwash on cowpea for mildew disease and the study revealed that usage of 20-30 percent vermiwash will cause suppression of mycelia growth of fungi. Vermicompost and vermiwash were proven to be able to control disease powdery mildew at 75.14 % rate when applied. On the other hand, combination of vermicompost, vermiwash and 10 % cow urine which said to be able to control disease at 73.37 % rate. It is also reported that vermiwash obtained from animal dung with gram bran and neem oil was also highly effective in controlling pod borer (*Helicoverpa armigera*). Spray of vermiwash along with biopesticide also increased the productivity of gram crop up to 3 times with respect to control (Nath and Singh, 2015) ^[25].

1.6 Effect on soil properties

Use of Organic formulations in agriculture could be a dynamic source to move forward soil fertility (Verma *et al.*, 2017) ^[37]. Combination of vermicompost and vermiwash [VW+VC] 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 (Ansari and Sukhraj, 2010) ^[2]. Tharmaraj *et al.*, (2011) ^[33] reported that soil treated with vermicompost and vermiwash mixture had significantly enhanced soil physico-chemical properties when compared to unamended soil. Tripathi *et al.* (2005) ^[34] suggested that vermiwash increases the number of microorganisms in the soil which helps in the decomposition of organic matter. Manyuchi *et al.* (2013) reported that soil zinc, manganese and iron content was unaffected with the increasing application of vermiwash but Increasing the application time of the bio-fertilizers resulted in decreased

zinc content to less than 1.0 mg/L and manganese content by less than 70 mg/L and increased iron content by more than 180 mg/L. However increasing the vermiwash quantity applied resulted in decreased copper content by less than 5.25 mg/L increasing the application time of the bio-fertilizers resulted in increased soil copper content by more than 8.0 mg/L.

Vermiwash a liquid biofertilizer rich in the primary nutrients i.e. nitrogen (N), phosphorous (P) and potassium (K) (Nath *et al.*, 2009 and Palanichamy *et al.*, 2011)^[11, 35]. Application of vermiwash has been reported to revitalize the soil quality (Gopal *et al.*, 2010)^[21]. It rejuvenates the depleted soil fertility and enriches available pool of nutrients, conserves moisture and natural and biological resources. Studies revealed that application of coconut leaf vermiwash increased the crop production capacities of soil by (i) enhancing the organic carbon contents in the soil and (ii) increasing the populations of the soil microorganisms, particularly plant beneficial ones, and their activities which would have facilitated increased uptake of the nutrients by the plants resulting in higher growth and yield.

2. Conclusion

The effect of vermiwash was observed on the plants and soil, it was found that vermiwash seems to possess an inherent property which acts not only as a liquid organic biofertilizer which promotes growth of plants and yield but also 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.

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