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# Efficacy of vermicompost in agriculture: A review

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**Abstract**
Management of solid waste in recent time is one of the biggest challenges. Vermicomposting is one of innovative technology for treating this waste and converting it into organic gold. It has come out as one of most promising sustainable approach for decomposing the waste. Vermicomposting uses earth worm for converting the biodegradable waste into humus. It is environmentally friendly and cheap technology. It has the potential as one of the prominent fertilizer f or plant growth. Moreover, it has less deleterious effect than the chemical fertilizer. Therefore, the present work is an attempt to study the efficacy of vermicompost in sustainable agriculture. All the publications hitherto regarding vermicompost were studied. The study reveals that, in general, vermicompost from all sources including both the plant and animal are highly potent fertilizers. As they have rich source of macro and micro nutrient present in them. They also possess some pest replant activities. The present knowledge will open up new avenues of vermicompost and give it due importance.

**Keywords:** earthworm, fertilizer, micronutrient, pest replants, sustainable agriculture, vermicompost

## Introduction

In recent times the harmful effect of chemical fertilizers has been well elucidated and it has opened new ways for sustainable approach of agriculture. Vermicomposting has been the major pillar for organic farming. It converts the biodegradable substance into organic humus or black gold rich in macro and micro nutrients. Vermi composting stabilizes the solid waste into a finished organic fertilizer (Edwards *et al*. 2011) [5]. Moreover, it is a process in which microorganisms and earthworms are utilized under mesophilic condition. They are most active at 10˚C to 32˚C, this range of temperature occur within the pile of moist organic matter. In the process, the nutrients contained in the organic matter are partly converted to their bioactive forms which are suitable for plant uptake. Vermicompost not only contain a heavy amount of organic carbon in addition to it has hormones and enzyme that have potential for growth and defence of the plants. A numerous case showing vermicompost amendment has led to development of defenses in plant have come up in recent times and also verified (Gajalakshmi S & Abbasi, 2002) [6] Also amendment by vermicompost provide conducive environment for beneficial microbes. As a result, the heterogeneity of microbes gets increased which in turn helps in the growth of the crop.

Vermicompost is an excellent soil nutritive consisting of earthworm cast. Earthworm cast contain the nutrition in higher concentration than the common fertilizer. (Parkin & Berry, 1999) [16]. It improves the essential oil productivity and quality accompanied by nutrient uptake by the plant of sweet basil (Rezaei-Chiyaneh, *et al*. 2021) [18]. Chicken manure and kitchen converted vermicompost increases the yield and quality of eggplant and is a better substitutes for chemical fertilizer (Goud, 2020) [8]. Bio humus or Vermicompost increases the immunity system and the yield of different species of crop plants (Shetinina *et al.* 2018) [20].

Vermicompost has numerous beneficial properties due to which it stands out as an excellent fertilizer for crops. It not only serves as rich source of Nitrogen, Potassium and Phosphorus but has a profound effect on the physical and biological properties of soil. It increases the water holding capacity, porosity and stabilizes the pH. Biologically the microbial diversity is enhanced. Overall vermicomposting is the key to sustainable agriculture.

Recent agriculture research and scientific reports suggested that vermicompost is highly profitable for use and a better substitute of chemical fertilizer. It increases both the productivity and quality of crops. Therefore, the present study aims to give vermicompost its due importance. As previously there are few sporadic reports and less documentation of vermicomposting. Which is a natural process and less harmful to ecosystem. It is also cost effective and is highly beneficial for crop production. A new addition to the method of organic farming. All these gave the impetus to carry out this review and document the advantage of vermicomposting in organic farming.

## Materials and Methods

### Literature Review

The literature for this review was extracted from the peer-reviewed articles, book chapters, and conference proceedings published in the last decade.

### Search Engines

The search engines used were PubMed, Google Scholar, Science Direct, Scope Med Mendeley and Research Gate. The search terms, such as 'Vermicomposting, Worm Casting Vermi wash and Sustainable agriculture', and their combinations were used (Bhatta *et al*, 2020) [3].

## Results and Discussions

The study reveals that much in past years enormous research articles were published depicting the effect of vermicompost on the soil health as compared to influence of vermicompost over germination, yield and disease resistance. (Fig-1)

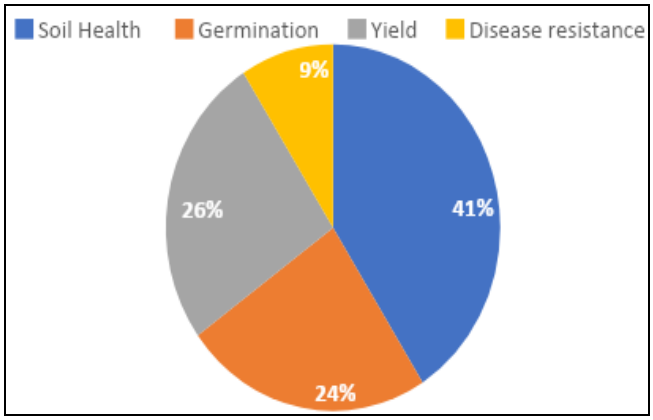


**Fig 1:** Depicting the role of vermicompost in Organic Farming

### Effect of Vermicompost on Seed Germination

The present findings does not indicate a clear result In majority of cases the VC was promoting the seed germinations however in some cases it failed to carry out the germination process after certain concentration and in some cases there is total inhibition occur. 44% of crops, shows increase in germination, 40 % of the crops depict an enhancement up to certain concentration thereafter their rate decreases. In 5% of reports, only inhibition was shown, and 12% reported no impact. Thus, 84% of studies claimed that VC facilitates seed germination, at least up to certain levels of application. Seed germination is internally controlled by genes and metabolic activity. However several physical, chemical and biological factors such as water, temperature, light, humidity and hormones plays a pivotal role in germination of seeds (Najar *et al*, 2015) [15]. (Table-1)

**Table 1:** Effect of vermicompost (VC) on seed germination.

| Sl.no | Source of VC | Plant Species | Results | References |
|---|---|---|---|---|
| 1 | Cattle dung | Flax | Improved the performance of seeds | Makar *et al*, 2017 [10] |
| 2 | Rice waste | Tomato | Further increase in the VC concentration had no significant effect. Enhanced the germination | Truong and Wang, 2015 [22] |
| 3 | Cow manure | Peas | Lower concentration inhibit the germination | Xu and Li, 2010 [25] |
| 4 | Cow dung and Leaves | Chickpea | Has no significant impact on growth of plants | Yadav and Garg, 2015 [26] |
| | Fly ash and Pine Bark | Marigold | Increases the rate of germination | Mupambwa *et al*, 2016 [14] |

### Effect of VC on Growth and Yield

The investigation shows that VC exerts a positive impact on growth and yield. About 95 % of the crops shows beneficial impact up to a certain limit of VC. Which clearly indicates that VC is a good fertilizer as compared to synthetic one. However its action is limited by stage of the plant, species and its use. Which includes either individually or mixture and amendments processes. For example, with farmyard manure and chemical fertilizers. Its activity is also regulated by agricultural practises and agroclimatic regions.

Actually, the vermicompost increases the nutrition in the soil and make them easily soluble for intake. Therefore, the plants get a good amount of nutrition which get reflected in their growth and yield. (Table-2)

**Table 2:** Effect of vermicompost (VC) on growth and yield.

| Sl.no | Source of VC | Plant Species | Results | References |
|---|---|---|---|---|
| 1 | Chicken manure | Cucumber | Significant increase | Zhao *et al*, 2017 [27] |
| 2 | Rice waste | Tomato | The yield was higher than other treatments | Truong *et al*, 2017 [21] |
| 3 | Cow dung | Flax | Lower concentration inhibit the germination | Makkar and Prakash, 2017 [10] |
| 4 | Dairy manure | Strawberry | Has no significant impact on growth of plants | Broz *et al*, 2017 [4] |
| 5 | Cattle manure | Sorghum | Increases the rate of germination | Sharif *et al*, 2016 [19] |

### Effect of Vermicompost on Soil Health

In the present review there is a positive influence of VC on the Soil health. The health of soil improves due to the following reasons. (1) Vermicompost is very rich in organic humus content. The particles present in vermicompost help to increase the pore space and water retention capacity of the soil, Simultaneously it decreases soil's bulk and particle density (Atiyeh *et al*, 2000) [2] (2) There is a higher concentration of nitrogen, phosphorus, potassium and calcium in VC as compared with other fertilizer. These available nutrients are when found in the soil they become cheap source of nutrition for the plant (Moreno *et al*, 2014) [13]. (3) There is an increase of microbial diversity in VC as earthworm excretes different proteins, polypeptides and nitrogenous substance which act as source of food for microorganism. In the gut of the earthworm, the size of micropore increases rather than macropore. This enhances the availability of both water and nutrients to microorganisms, thus increasing the heterogeneity of microbial flora they in turn secretes different enzymes, hormones and growth regulators beneficial for the growth of the plant (Manna *et al*, 1997) [11]. (4) VC stabilizes the pH content of the soil. Several experiments performed showed that pH of the soil improves when VC is applied to it (Maheswarappa *et al*, 1999) [9]. The pH of the wormcast is neutral therefore when this is added to the soil it brings the pH to neutral condition (Table-3)

**Table 3:** Effect of vermicompost (VC) on growth and yield

| Sl.No | Source of VC | Plant Species | Results | References |
|---|---|---|---|---|
| 1 | Cow Dung | Oryza sativa | Soil Soil nutrient content (total nitrogen available and phosphorus increased). Microbial Biomass increased | Wu *et al*, 2013 [24] |
| 2 | Vegetable waste | Tomato | Application of VC and compost improved the soil nutrient. | Goswami *et al*, 2017 [7] |
| 3 | Crop residues | Maize | Enhanced the organic carbon | Ramchandran, 2017 [7] |
| 4 | Vegetable waste | Horticulture crops | The bulk density decreases of soil and water-soluble elements, increased with increasing amounts of VC in the substrate, | Melgar *et al*, 2017 [12] |

| | | | | |
|---|---|---|---|---|
| 5 | Fly ash and Cow Dung | Brinjal | VC improved the physico-chemical properties, enzymatic activities, microbial biomass, carbon and microbial population. | Usmani *et al*, 2019 [23] |

**Effect of VC on Plant Defenses**

Numerous studies have shown that VC can decrease a wide range of disease caused by pest and microbe consisting of fungi, bacteria and virus. It has been well proved that VC amendment significantly develops defenses in the plant due to which they become less susceptible to disease (Arancon *et al*, 2007) [1].

**Conclusions**

The recent review reveals that VC is a major tool for organic farming or sustainable agriculture. The earthworm which is called as farmer's friend really worth of its name. They improve the conditions of the soil and provide macro and micronutrient towards the growth of the plant. The worm casts of it contain rich source of nitrogen, phosphorous, potassium and calcium. The VC derived from any source whether animal, plant or Phyto mass have a positive impact on the growth of the plant. However its activity is limited by its concentration. A right amount of concentration is needed for its action.

We can conclude that use of VC in current agricultural practice will lead to sustainable approach of agriculture or organic farming, which is beneficial to the ecosystem. More works to be done to exploit more the relationship of earthworm and growth of crops.

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