**Effects of Vermicompost and Vermiwash on**

**the Exo-morphological Features of Common Bean (*Phaseolus vulgaris* L.) Plants**

**ABSTRACT**

The experiment was carried out during 2023-24 at the department of Life Sciences, Sibsagar University, Assam to observe the effect of the application of vermicompost and vermiwash on growth of bean plants. Vermicompost was prepared by using earthworm, *Eisenia foetida*. Vermiwash was prepared from the same vermibed. It was observed that throughout the experiment the bean plants grew well gradually with increasing amount of vermicompost as compared to control plants. The shoot length of common bean plant, *Phaseolus vulgaris* was found maximum i. e. 25.37 +1.81 cm in 700 g of vermicompost with 300 g of soil. Maximum root length of 11.93 +2.71 cm was found in the bean plants sprayed 5% vermiwash as foliar spray on the surface of the leaves. Some physico-chemical properties of the vermicompost and vermiwash were also observed. The pH of harvested vermicompost and vermiwash were found 7.27 +1.23 and 9.30 +1.21 respectively. The results of the present study clearly suggest that 700 g of vermicompost with 300 g of soil and 5% vermiwash could be used on bean plants in the near future.

*Keywords:*Vermicompost, vermiwash, physico-chemical properties, growth of bean plant.

1. **INTRODUCTION**

Vermicomposting is the process of conversion of biodegradable matter by earthworms into vermicompost. Vermicompost has a great potential as plant growth media. Vermicompost is a finely divided peat-like material with excellent structure, porosity, aeration, drainage and moisture holding capacity (Edwards, 1988). During the processing of the wastes by earthworm, many of the nutrients that they contain are changed to forms which are more readily taken up by plants, such as nitrates, ammonium nitrogen, exchangeable phosphorus, soluble potassium, calcium and magnesium (Edwards and Bohlen, 1996). Vermicompost has been scientifically proved as miracle plant growth enhancer (Chaoui et al. [2003](https://link.springer.com/article/10.1007/s40093-017-0191-5#ref-CR10)). Vermicomposting is an aerobic, biological method and is proficient to convert eco-friendly humus like organic substances (Chanda et al. [2011](https://link.springer.com/article/10.1007/s40093-017-0191-5#ref-CR9)).

Vermiwash is a liquid extract of vermicompost and earthworms, which used on various crops for enhance the productivity in agriculture and horticulture (Chauhan and Singh, 2012). Different types of vermiwash that formed from differenttypes of vermicompost have different levels of nutrients. Vermiwash is the coelomic fluid extractions have enzymes and rich in nutrients, which stimulates the growth and yield of crops (Ansari, 2008). This liquid is collected from the culture tanks and after diluting it is used as foliar spray to different plants. The fluid that is collected can stored in bottles for further uses. The present investigation was carried out to observe the effect of the application of vermicompost and vermiwash on growth of been plants. Vermiwash is used as a foliar spray that plants can easily absorb (Manyuchi et al. 2013; Kaur et al. 2015). The foliar application of vermiwash is also reported to have a pesticide effect, with plants showing less or no incidence of diseases and pests (Verma et al., 2018). The physico-chemical properties of the harvested vermicompost and vermiwash were also observed.

**2. MATERIALS AND METHODS**

**2.1. Preparation of vermicompost**

The vermiculture beds (2' x 2' x 3' in size) located at the Botanical garden of the Sibsagar University, Assam were used for vermicomposting.

1. **Substrate application:** The substrates were the mixture of loam soil, cow dung, partially decomposed leaves, partially decomposed rice straw, vegetable waste and shredded moist newspapers. Before putting the substrate, the materials were cut or break into smaller pieces. To retain the moisture, water was added regularly and covers the vermi beds with roof and jute cloth. The substrates were kept in the beds for ten days before put the vermi worms.
2. **Introducing the vermi worms**: The earthworm species *Eisenia foetida* was collected from Assam Agricultural University, Jorhat and introduced in the vermi beds for decomposition of the substrates.
3. **Feeding the vermi worms**: After introducing the vermi worms, fed the worms by placing vegetable wastes and also leaves of suitable plants. The vegetable wastes were placed in a different place each time for the worms to easily feed into it. After two weeks, the vermi worms were eaten the food waste leaving behind worm casting or compost.
4. **Harvesting of vermicompost**: Harvesting was commencing 10 to 14 days or 2 weeks after stocking of worms. Prior to harvest, was stopped from watering the substrate for the last three days to ease the separation of castings from worms and likewise preventing the castings to become compact. Then the first harvest of the vermicompost or the worm manure was done from the vermi bed.
5. **Re-applying substrates and re-introduction of the vermi worms**: After the harvest of the vermicompost, new substrates were put in the vermi beds and were re-introduction of the vermi worms for the continuity of the worm’s culture and for their production of the vermiwashwhich are very good organic fertilizer. After introducing the worms into the substrates, were sprinkled it with water to keep the moisture on which worms can easily digest these substrates.

**2.2. Preparation of vermiwash**

A 20-30 liter capacity plastic container was collected and is converted into a vermi bed for obtaining vermiwash. The container was drilled and fitted with a plastic tap at its bottom for periodic collection of vermiwash. The unit was kept on a stand of about 10-15 cm height for support and was having an arrangement of draining out water from the bottom in the form of vermiwash.

A basal layer of broken pieces of bricks were filled to a height of about 3 inches. Above this a layer of coarse sand was filled up to 3 inches thickness. On the top of it again a layer of 3 inches thickness was put general soil layer and above it about 5 inches compost or old cow dung layer was mixed with organic waste of plant origin obtained from weeds. A layer of mulch is placed above it and earthworms about 50 numbers were introduced in the unit and the top of unit was slowly moistened with water and the bottom tap is kept open for about 10 days to drain out inside water and to maintain the moisture content.

After 15/16 days, the tap was closed and after a period of 30 days vermiwash was obtained. A plastic container was fitted at the top of vermibed having holes in its base which will be filled with freshwater which slowly drips drop by drop on the vermiculture unit moistening it and producing vermiwash subsequently after going through the unit. After a span of about 30 days the bottom tap of the vermibed was slowly opened and the vermiwash was collected in conical flasks as stock for further experiments. From the stock solution desired concentrations like 1%, 3%, 5% were made by dilution with distilled water.

**2.3. Effect of the vermicompost and vermiwash on growth of the plants**

The experiment was carried out during 2023-24 at the department of Life Sciences, Sibsagar University, Assam to observe the effect of the application of vermicompost and vermiwash on growth of bean (*Phaseolus vulgaris* L.) plants. The harvested vermicompost was tested as organic fertilizer for bean seedlings in pot culture experiment to observe their effect on growth on plants. In this experiment, clay soil, red soil and sand were collected from in and around Joysagar area. The seeds of bean were collected from Agricultural Centre, Sivasagar. Pot culture studies were carried out to find out the effect of vermicompost and vermiwash on growth of been plant. Pots of 20 cm height and 15 cm diameter were used for the experiment. At least 2 bean plants were maintained in each pot after germination of seeds. Different concentration of vermicompost viz. 300 g vermicompost with 700 g of soil; 500 g of vermicompost with 500 g of soil and 700 g of vermicompost with 300 g of soil were used for the experiment. There was 1000 g soil only in the control.

Different concentrations of vermiwash viz. 1%, 3%, 5% were sprayed as foliar spray on the surface of the bean leaves. The control test was carried out with distilled water only.

The exo-morphological parameters such as shoot and root length, number of branches and leaves, leaf length and breadth were recorded on the 50th day to observe the growths of the plants.

**2.4. Study the physico-chemical properties of prepared vermicompost and vermiwash**

The physical as well as chemical characteristics of the collected vermicompost and vermiwash were done by following the methods of Sinha et al. (2014). According to their methods physicochemical properties of prepared vermicompost and vermiwash was observed time to time. The physicochemical characteristics like temperature, moisture, pH and water holding capacity were determined after harvesting.

Three replications were maintained for each experiment. Statistical analysis was carried out following the procedures of Prasad (1992)

3. **RESULTS AND DISCUSSIONS**

The effect of vermicompost and vermiwash cultured from *Eisenia foetida* on the growth of bean plants are shown in the table-1 and table 2 respectively.

Parameters such as leaf length and breadth; shoot and root length; number of branches and leaves were observed in the experimental. It was observed that throughout the experiment the bean plants grew well gradually with increasing amount of vermicompost as compared to control plants. The shoot length of been plant was found 21.16 +1.23, 22.96 +2.17, 25.37 +1.81 and 18.23 +1.23 cm in 300 g vermicompost with 700 g of soil, 500 g of vermicompost with 500 g of soil, 700 g of vermicompost with 300 g of soil and in control respectively (Table 1). Number of branches and number of leaves was found maximum from the pot in which 700 gm vermicompost with 300 gm of soil was added which may be due to added more vermicompost in the soil. Maximum root length (13.50 +1.24 cm) was observed in the bean plants with 500 g of vermicompost with 500 g of soil which may indicate that the equal amount of soil and vermicompost may be suitable for the growth of the roots.

The parameters like number of leaves, number of branches, root length and shoot length gradually increased with increasing amount of vermiwash (Table 2). Maximum root length of 11.93 +2.71 cm was found in the bean plants sprayed 5% vermiwash as foliar spray on the surface of the leaves.

**Table 1. The effect of vermicompost harvested from *Eisenia foetida* on the growth of bean plants**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Parameters** | **Control**  **(1000g Soil only)** | **In the ratio of vermicompost and soil** | | |
| **300 g :700 g** | **500 g: 500 g** | **700 g: 300 g** | |
| Leaf length(cm) | 3.75 +1.32 | 6.26 +3.23 | 7.41 +3.71 | 7.26 +2.12 | |
| Leaf breath(cm) | 2.73 +1.65 | 3.73 +1.32 | 4.43 +2.12 | 5.00 +2.23 | |
| Shoot length(cm) | 18.23 +1.23 | 21.16 +1.23 | 22.96 +2.17 | 25.37 +1.81 | |
| Root length(cm) | 9.96 + 1.12 | 11.90 +3.92 | 13.50 +1.24 | 12.66 +1.74 | |
| No. of branches | 5.33 +2.71 | 7.33 +2.73 | 8.66 +3.14 | 10.66 +2.71 | |
| No. of leaves | 9.00 +2.19 | 18.00 +2.27 | 22.00 +1.19 | 25.00 +1.16 | |

*\*Each mean (+SD) data represent the three replications*

**Table 2. The effect of vermiwash harvested from *Eisenia foetida* on the growth of bean plant**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Parameters** | **Control**  **(Distilled water only)** | **Concentration of vermiwash\*** | | |
| **1%** | **3%** | **5%** |
| No. of leaves | 11.00 +1.23 | 22.33 +1.71 | 17.66 +1.23 | 23.33 +2.61 |
| No. of branches | 5.66 +1.10 | 6.66 +0.83 | 6.66 +1.29 | 8.33 +1.54 |
| Root length(cm) | 7.90 +1.09 | 7.53 +1.27 | 8.06 +2.16 | 8.71 +1.63 |
| Shoot length(cm) | 12.40 +2.19 | 10.40 +0.91 | 11.30 +3.21 | 11.93 +2.71 |

*\*Each mean (+SD) data represent the three replications*

**Table 3. Physico-chemical properties of vermicompost and vermiwash harvested from *Eisenia* *foetida*.**

|  |  |  |
| --- | --- | --- |
| **Parameters** | **Vermicompost** | **Vermiwash** |
| P H | 7.27 +1.23 | 9.30 +1.21 |
| Water holding capacity (%) | 40.23 +2.16 | - |
| Moisture content(gm) | 19.76 +2.71 | - |
| Temperature (°C) | 33.50 +1.96 | 30.00 +1.31 |

*\*Each mean (+SD) data represent the three replications*

The physico-chemical characteristics of vermicompost and vermiwash is presented in Table 3. The pH of harvested vermicompost and vermiwash were found 7.27 +1.23 and 9.30 +1.21 respectively. On the other hand temperature was found a little more in vermicompost than the vermiwash. These differences may be due to two different forms viz. solid and liquid. The results of the physicochemical properties are shown in Table 3 and agree with the work done by Ansari and Sukhraj (2010). Although it had to be noted that several researchers found different nutritional value for the vermiwash, because the nutritional value depends on the feed used for the vermicomposting process and quality of the vermicompost (Zaefarian and Rezvani, 2016).

It was found that vermiwash exhibit growth promoting on morphological characters like plant height, length, number of leaves and branches, root length and shoot length. Similar observations were also observed by Rajan & Murugesan (2012) on influence of vermiwash on germination and growth of Cow Pea Vigna Ungiculata and Rice, *Oryza Sativa*. Significant germination, growth and productivity (g/m) was observed after the foliar 2 spray of vermiwash with leaf aqueous extract of neem (*Azadirachta indica* ) with respect to control (Kumar & Singh, 2014). Rekha et. al (2018) reported that 50% vermicompost treatment showed great potential to increase the performance, growth of chilly plant and improvement of soil quality. Awadhpersad et al, (2021) also reported that the height, shoot fresh and dry weight, root weight, root density, root length, yield and fruit weight were higher for the tomato plants treated with a combination of vermicompost and vermiwash.

4. **CONCLUSION**

The results of this study showed that vermicompost and vermiwash treatment showed great potential to increase the growth and development of bean plants. Bean plants grown in vermicompost-amended soil showed enhanced growth rate when compared to plants treated with control. The study positively highlights the importance of organic farming; therefore, vermicompost may be put to good use as a natural fertilizer for cereals and vegetable crops for increased production and for sustainable agricultural systems. Thus, the results of the present study clearly suggest that 700 g of vermicompost with 300 g of soil and 5% vermiwash could be used on bean plants in the near future.

**DISCLAIMER (ARTIFICIAL INTELLIGENCE)**

Author(s) hereby declare that NO generative AI technologies such as Large Language Models (ChatGPT, COPILOT, etc) and text-to-image generators have been used during writing or editing of this manuscript.

Disclaimer (Artificial intelligence)

Option 1:

Author(s) hereby declare that NO generative AI technologies such as Large Language Models (ChatGPT, COPILOT, etc.) and text-to-image generators have been used during the writing or editing of this manuscript.

Option 2:

Author(s) hereby declare that generative AI technologies such as Large Language Models, etc. have been used during the writing or editing of manuscripts. This explanation will include the name, version, model, and source of the generative AI technology and as well as all input prompts provided to the generative AI technology

Details of the AI usage are given below:

1.

2.

3.

**REFERENCES**

Ansari, A. A. (2008). Effect of vermicompost and vermiwash on the productivity of Spinach (*Spinacia oleracea*), Onion (*Allium cepa*) and Potato (*Solanum tuberosum*). *World Journal of Agricultural Sciences*, 4 (5): 554-557.

Ansari, A. A. & Sukhraj, K. (2010). Effect of vermiwash and vermicompost on soil parameters and productivity of okra (*Abelmoschus esculentus*) in Guyana. *Afr J Agric Res*. 5 (14): 1794-1798.

Awadhpersad, V. R. R., Ori, L. & Ansari, A. (2021). Production and effect of vermiwash singly and in combination with vermicompost on the growth, development and productivity of tomato in the greenhouse in Suriname, Asian Journal of Agriculture, 5(1): 29-34.

Chaoui, H. I. & Zibilske, L. M, O. (2003). Effects of earthworms cast and compost on soil microbial activity and plant nutrient availability, *Soil Biol Biochem,* 35:295–302.

Chanda, G. C., Bhunia, G. & Chakraborty, S. K. (2011). The effect of vermicompost and other fertilizers on cultivation of Tomato plants. *J Hortic For*, 3: 42–45.

Chauhan, H. K. & Singh, K. (2012). Effect of binary combinations of buffalo, cow and goat dung with different agro wastes on reproduction and development of earthworm *Eisenia foetida*. *World J. Zool*ogy, 7(1): 23-29.

Edwards, C. A. (1988). Breakdown of animal, vegetable, and industrial organic wastes by earthworms. *Agriculture Ecosystem Environment*, 24: 21-31.

Edwards, C. A. & Bohlen, P. J. (1996). *Biology and Ecology of earth worms*. 3rd Edition. Chapman and Hall, London.

Kaur, P., Bhardwaj, M., & Babber, I. (2015). Effect of vermicompost and vermiwash on the growth of vegetables. *Res J Anim Vet Fish Sci*, 3 (4): 9-12.

Kumar, H. & Singh, C. K. (2014). Potency of vermiwash with *Azadirachta indica* A. Juss on Yield of Gram (*Cicer arietinum*) and Infestation of *Helicoverpa armigera* (Hübner). *American-Eurasian Journal of Toxicological Sciences*, 6 (4): 87-93.

Manyuchi, M. M., Phiri A, Muredzi, P., & Chitambwe, T. (2013). Comparison of vermicompost and vermiwash bio-fertilizers from vermicomposting waste corn pulp. *Intl J Agric Biosyst Eng,* 7 (6): 389-392.

Prasad, S. (1992). *Fundamentals of Biostatistics (biometry)*, [1st ed]. Emkay Publication, New Delhi.

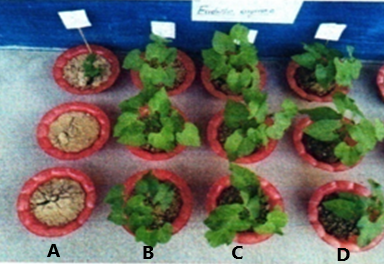
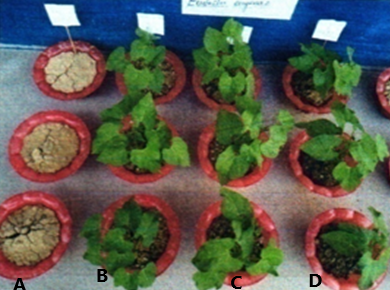
Rajan, M. R. & Murugesan, P. (2012). Influence of Vermiwash on Germination and Growth of Cow Pea Vigna Ungiculata and Rice, *Oryza Sativa*. *Journal of Pharmacy*, 2 (6): 31-34.

Rekha, G. S., Kaleena, P. K., Elumalai, D., Snkumaran, M. & Maheswari, V. N. (2018). Effects of vermicompost and plant growth enhancers on the exo-morphological features of *Capsicum annum* (Linn.) Hepper, *International J. of Recycling of Organic Waste in Agriculture*, 7: 83-88

Sinha, J., Chatterjee, A. K. & Chattopadhyay, P. (2014). *Advanced practical zoology,* [3rd ed]. Books and Allied (P) Ltd.

Zaefarian, F., Rezvani, M. ( 2016). 5 -Soybean (*Glycine max* L. Merr.) Production Under Organic and Traditional Farming. In: Environmental Stresses in Soybean Production. Academic Press, New York.

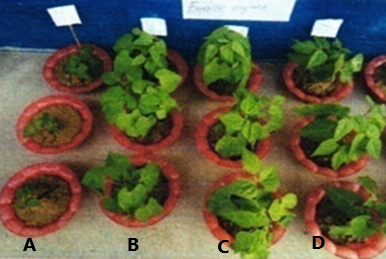
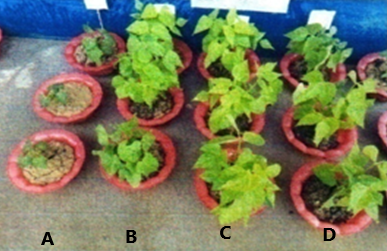
\*\* \*\* \*\*

After 25 days After 50 days

**A**-Control (Distilled water), **B**-1%, **C**-3%, **D**-5% (vermiwash)

Fig. 1. **Experimental set up to observed on influence of vermiwash on bean plants growth.**

After 25 days After 50 days

**A**-Control (soil only), **B**-300g : 700g, **C**- 500g : 500g, **D**-700g : 300g (vermicompost : soil)

Fig. 2. **Experimental set up to observed on influence of vermicompost on bean plants growth.**