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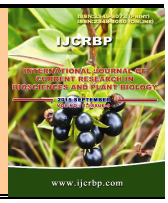

Original Research Article

Effect of Vermiwash on the Growth Parameters of *Solanum melongena* L. (Brinjal Plant)

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Abstract

Vermiwash is an organic fertilizer obtained from the unit of vermiculture (*Eisenia fetida*), as drainage. Vermicompost is also collected from the same vermiculture unit. It is used both as foliar spray and is applied in the root zone of plants. Present study examines the effect of vermiwash on the growth of *Solanum melongena* L., (Brinjal) plant. When Vermiwash was added in the soil as well as sprayed on the *Solanum melongena* L., the observations showed a significant growth of plants i.e., length of shoot as well as number of leaves per plant. Vermiwash when mixed in the soil as well as sprayed on plants has increased the shoot length to (10 cm) as compared to vermicompost (8.4 cm) and control (7.4 cm), respectively. Similarly vermiwash has also increased another parameter, the number of leaves to 5.8 as compared to, vermicompost 5.3 and control 5.0 respectively. It can be concluded that the growth of *Solanum melongena* L. showed much positive result when grown in vermicompost. However, the results were even better, when the plants were treated with vermiwash. Chemical analysis of vermiwash showed high P, K, Ca content as compared to vermicompost and soil. Chemical analysis of vermiwash showed presence of high level of macro nutrients like P, K, Ca but low levels of micro nutrients like Zn, Cu, Fe and Mn. Therefore it may be concluded that significant increase in the growth of vermiwash treated plants was observed due to high level of macro nutrients available in the vermiwash. Hence vermiwash proves to be an effective biofertilizer which contributes to the growth of plants.

Keywords

Brinjal

Eisenia fetida

Organic fertilizer

Vermicompost

Vermiwash

Introduction

Due to increasing population and development of human civilization, industrialization increased the problem of environmental degradation. The rapidly use of chemical fertilizer and pesticide destroyed the fertility of soil and also produce the harmful diseases for crops and human mankind. Application of chemical fertilizers over a

period has resulted in poor soil health, reduction on produces, and increases in incidences of pest and disease and environmental pollution (Ansari and Ismail, 2001). To cope up with these trenchant problems, the vermitechnology has become the most suitable remedial device fertilizers/pesticides, recycle and regenerate waste into wealth; improve soil, plant, animal and human health; creating an eco-friendly, sustainable and economical bio-system models (Ansari and Ismail, 2001). Therefore organic farming helps to provide many advantages such as eliminate the use of chemical in the form of fertilizers/ pesticides.

The role of earthworm in soil formation and soil fertility is well documented and recognized. An approach towards good soil management, with an emphasis on the role of soil inhabitants like earthworms, in soil fertility, is very important in maintaining balance in ecosystem (Shuster et al., 2000).

Vermicomposting technology is the decomposition of organic waste into nutrient rich vermicasts through the combined action of earthworms and microorganism's by which the earthworms also increase in number, size and weight (Manyuchi et al., 2012; Quaik et al., 2012). Vermiwash is a liquid that is collected after the passage of water through a column of worm action. It is a mixture of excretory products and mucus secretion of earthworms along with micronutrients from the soil organic molecules. It is very useful as a foliar spray.

The vermiwash also contains enzymes and secretions of earthworms and would stimulate the growth and yield of crops. Zambare et al. (2008) conclude that vermiwash contains various enzymes cocktail of protease, amylase, urease and phosphatase and also microbial study of vermiwash found that nitrogen fixing bacteria like *Azotobacter sp., Agrobacterium sp.*, and *Rhizobium sp.*, and some phosphate solubilizing bacteria.

Kale (1998) reported that vermiwash as foliar spray was effective in increasing the growth and yield response of anthurium. Such a preparation would certainly have the soluble plant nutrients apart from some organic acids and mucus of earthworms and microbes (Shivsubramanian and Ganeshkumar, 2004). Hatti et al. (2010) reported that the seedling of *Vigna mungo, Vigna radiata, Sesamum indicum*, resulted in increase of growth of parameters lie the root length, shoot length, number of twigs and leaves and total biomass of the plant after spraying the vermiwash of *Perionyx excavates*. Vermiwash also protect the plant and crops as we use spraying method. This work is also related to the influence of vermiwash on the germination of tomato plant. Nitrogen (N), phosphorous (P) and potassium (K) are the primary (macro) nutrients found in any fertilizer. The nitrogen is necessary for promoting growth of leaves and stems. In addition, nitrogen gives plants their dark colour and improves the quality of foliage. Phosphorous stimulates plant growth, flower development and plant maturity (Shakhashiri, 2012; Kidder, 1997).

Materials and methods

Collection of earthworm: Although large numbers of indigenous and exotic species has been identified and are being used, but for Indian conditions three species namely *Eisenia fetida*, *Eudrilus eugeniae* and *Perionyx excavates* have been found to be very effective and are being exploited in large scale. The earthworms were collected from the local supplier Kalptaru, Mumbai. *Eisenia fetida* – a species of epigeic earthworm, used for the preparation of vermiwash (Fig. 2).

Construction of vermiwash unit (Fig. 3)*:* The experiment was performed in the laboratory. A vermiwash unit was designed as per Ismail (1997) with few modifications. Take a plastic container of 15 litres and hole was made at the bottom side. A layer of bricks 2-3cm breadth was poured in the bottom of container. A layer of sand of 2-3cm was maintained above this layer. Above to this layer, cow dung 3-4 cm was poured and then soil was poured above this layer about 2-3 cm. Then added 50 earthworms (*Eisenia fetida)* in the container. Final layer was kitchen waste as a food for earthworm.

A saline bottle was hanged above the container so that water comes out from the bottle in to the container drop by drop to keep the surface wet and moist during throughout the experiment. Every day 1 litre of water is to be poured in the saline bottle. Spray water regularly for a period of 7-8 days. After 10 days the liquid vermiwash will be produced in the bucket.

Extraction of vermiwash: The drops of water made the upper surface as well as different layers of bricks, sand, dung and soil wet and moist. Earthworms started decomposing the dung present in the container. Water sprinkled on the upper layer passes through the dung decomposed by the earthworms. Some coelomic fluid and excreta of earthworm gets mixed with the water

which is finally called "VERMIWASH" comes out in the vermiwash collection container directly through the hole. Thus vermiwash was collected in the separate clean containers for further use. The effect of vermiwash was observed on the various plant parameters. From the vermiwash unit, vermicompost as well as vermiwash (Fig. 4) were collected and analysed for various physico-chemical parameters as shown in Tables 1 and 2.

Pot experiment: Brinjal seed (*Solanum melongena)* packet Nirmal's Hybrid Brinjal NBH-1214 was used for the experiment (Fig. 1).

Treatment no. 1: 2 kg soil + vermiwash

Treatment no. 2: 1½ kg soil and ½ kg vermicompost + water

Treatment no. 3: 2 kg soil + water (Control)

All treatments are given in triplicates. Brinjal plants (*Solanum melongena*) sprayed with vermiwash and water alternate day at 11 am in the morning for 40 days on the brinjal plants (*Solanum melongena).* Observation noted on 10th, 20th, 30th and 40th day.

Fig. 1: Brinjal seed packet (NIRMAL'S HYBRID BRINJAL NBH-1214).

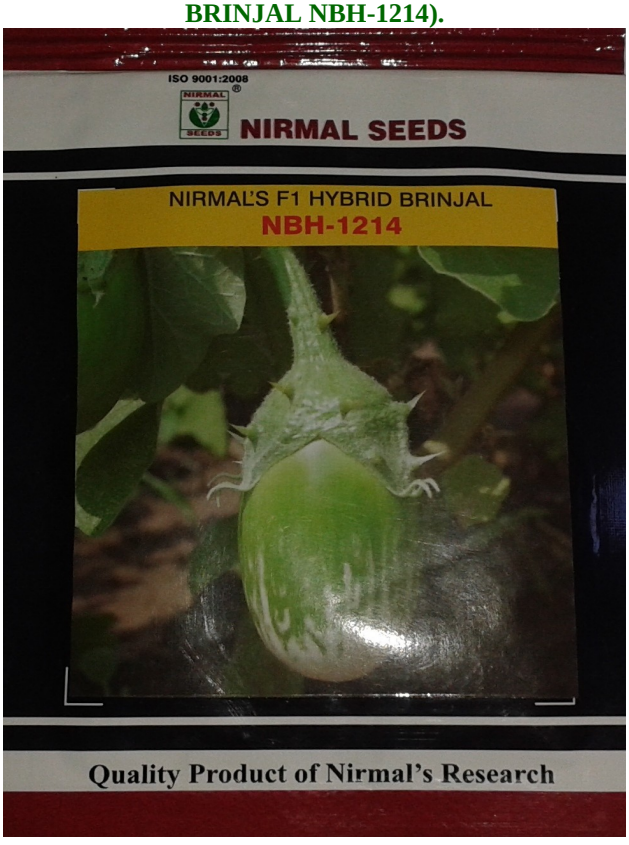
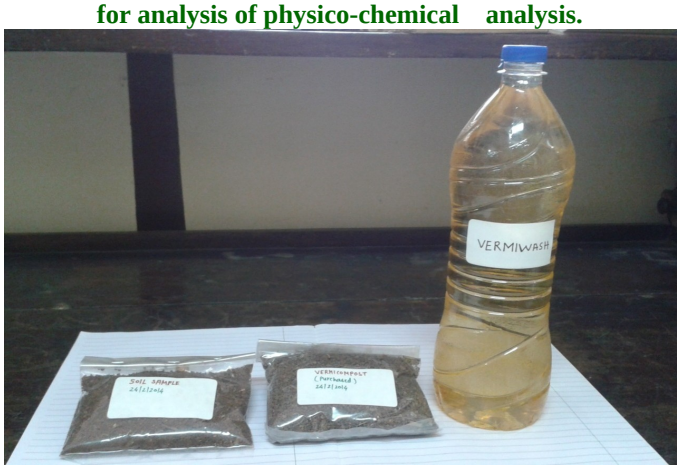


Fig. 2: Earthworm (*Eisenia fetida*) used for vermiwash and vermicompost collection.

Fig. 3: Vermiwash unit.

Fig. 4: Samples of soil, vermicompost and vermiwash used for analysis of physico-chemical analysis.



Results

Vermicompost and vermiwash was chemically analysed for various parameters i.e., total nitrogen (TN), total organic carbon (TOC), total available phosphorous (TAP), total potassium (TK), calcium (Ca), magnesium (Mg), copper (Cu), iron (Fe), manganese (Mn) and zinc (Zn) and the results are given in Table 1 and Table 2.

Table 1. Analysis of physico-chemical parameters of vermiwash, vermicompost and soil.

Sl. No.	Parameters	Vermiwash	Vermicompost	Soil
1	pH	7.18	5.90	6.33
2	Electrical conductivity (MʊO)	3.26	2.18	0.37
3	Calcium (meq /L)	300.23	120.64	101.92
4	Magnesium (meq/L)	65.93	8.64	0.69
5	Total nitrogen (%)	0.346	0.805	0.519
6	Total organic carbon (%)	5.54	12.88	8.31
7	Available phosphorus (%)	0.46	0.29	0.23
8	Potassium (mg %)	39.50	16.50	1.50

Table 2. Metal analysis of vermiwash, vermicompost and soil.

Sl. No.	Element	Vermiwash	Vermicompost	Soil
1	Zinc (mg/L)	0.02	1.47	5.60
2	Copper (mg/L)	0.08	0.54	0.87
3	Iron (mg/L)	0.07	475.74	1004.55
4	Manganese (mg/L)	0.04	19.80	49.25

Effect of various treatments on the shoot length of brinjal plant (Table 3 and Fig. 5)

Treatment 1: It includes, 2 kg of soil and vermiwash spray showed a significant increase in the length of shoot. Initially the length of shoot was recorded to be 4.6 cm on 10th day of experiment. The shoot length was again measured and recorded to be 5.7 cm and 7.3 cm on 20th day and 30th day. The length of shoot was recorded to be 10cm on 40th day that was significantly higher than the control group (7.4 cm).

Treatment 2: It includes, 1½ kg soil and ½ kg vermicompost, water spray showed a significant increase in the length of shoot. Initially the length of shoot was recorded to be 4.5 cm on 10th day of the experiment. Again an increased was observed in the length of shoot i.e., 5.4 cm and 6.6 cm as on 20th and 30th day. The length of shoot was recorded to be 8.4 cm at the end of the experiment i.e on 40th day.

Treatment 3: It includes 2 kg of soil only and water spray showed proper length of shoot. Initially the length of shoot was recorded to be 4.3 cm on the 10th day of the experiment. Again an increase was observed in the length of shoot i.e., 5.2 cm and 6.3 cm as on 20th and 30th day of the experiment. The length of shoot was recorded to be 7.4 cm at the end of the experiment i.e on 40th day that was significance.

Table 3. Effect of treatments on the shoot length of brinjal plants (*Solanum melongena* L.) in a period of 40 days study.

Treatments	Shoot length of brinjal (cm)			
	10 days	20 days	30 days	40 days
TR 1 (Vermiwash)	4.6	5.7	7.3	10.0
TR 2 (Vermicompost + water)	4.5	5.4	6.6	8.4
TR 3 (Soil + water)	4.3	5.2	6.3	7.4

Effect of various treatments on the number of leaves of brinjal plant (Table 4 and Figs. 6 and 7)

Treatment 1: The number of leaves in the plants with 2 kg soil and vermiwash spray on alternate days was found to be 2 on 10th day of the experiment. Again an increase was observed in the number of leaves i.e., 3.8 and 4.6 on 20th and 30th day. At the end of the experiment i.e., on 40th day it was 5.8 in numbers.

Treatment 2: The number of leaves in the plants with 1½ kg of soil and ½ kg vermicompost, water spray on alternate days was found to be 2 on 10th day of the experiment. Again an increase was observed in the number of leaves

i.e., 3.3 and 4.5 on 20th and 30th day of the experiment. At the end of the experiment i.e., on 40th day it was 5.3.

Treatment 3: The number of leaves in the plants with 2 kg soil and water spray on the plants as well as in the soil on alternate days was found to be two. Again an increase in number of leaves was observed i.e., 3 and 4 leaves on 20th and 30th day. At the end of the experiment the number of leaves observed was 5 which is less than that of the experimental plants.

Table 4. Effect of treatments on the number of leaves of brinjal plants (*Solanum melongena)* in a period of 40 days study.

Treatments	Number of leaves of brinjal			
	10 days	20 days	30 days	40 days
TR 1 (Vermiwash)	2.0	3.8	4.6	5.8
TR 2 (Vermicompost + water)	2.0	3.3	4.5	5.3
TR 3 (Soil + water)	2.0	3.0	4.0	5.0

Fig. 5: Effect of various treatments on the shoot length of brinjal plant (*Solanum melongena*).

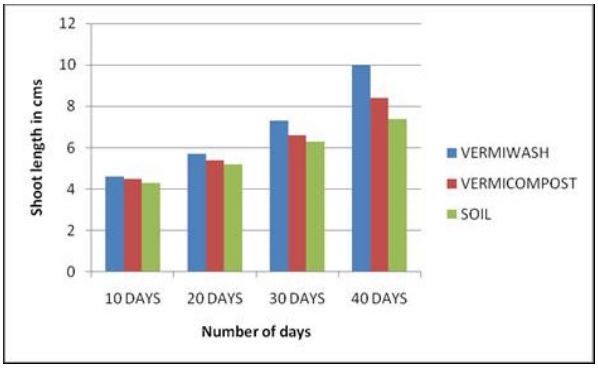


Fig. 6: Effect of various treatments on the number of leaves in the brinjal plants (*Solanum melongena*).

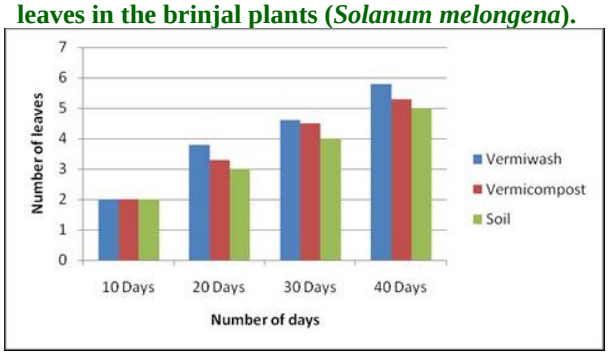


Fig. 7: Forty days old brinjal plant (*Solanum melongena*) in soil, vermiwash and vermicompost applications.

Discussion

It was observed that during the experiment, vermiwash when sprayed on the brinjal plants showed a significant effect on the growth parameters of brinjal plants (*Solanum melongena)* i.e. length of shoot as well as number of leaves per plant. When vermicompost was added in the soil the shoot length increased up to 8.4 cm which was higher compared to control which was 7.4 cm. Vermiwash when sprayed on the brinjal plants and added in the soil also increased the shoot length to 10.0 cm as compared to control as well as vermicompost.

The result was also observed for the increase in number of leaves in the brinjal plants. When vermicompost was added in soil, the numbers of leaves were 5.3 and in control plants it was 5.0. The significant increase was observed in the brinjal plants which were sprayed with vermiwash and also added in the soil, the number of leaves recorded to be 5.8 which was higher as compared to vermicompost as well as control.

Earthworm processed material 'casts' contain several soil nutrients in forms which are easily available to plants (Taylor et al., 2003). Earthworms rapidly convert the waste into humus-like substances with finer structure than thermophilic composts but possessing a greater and more diverse micro-bioactivity (Elvira et al., 1996; Atiyeh et al., 2000). Krishnamoorthy and Vajaranabhaiah (1986) reported relatively higher ranges of plant nutrients such as ammonia, urea, oxidisable organic matter and exchangeable forms of some essential plant nutrients. They also reported plant hormones, e.g. cytokinins and auxins in earthworm casts. Muscolo et al. (1999) also found an auxin like effect of earthworme worked humic substances on cell growth and nitrogen metabolism in *Daucus carota*. A few plant growth substances have also been reported in casts (Krishnamoorthy and Vajranabhaiah, 1986;

Muscolo et al., 1999). The effect of vermiwash treated soil in which Spinach and onion were grown, was found to be significantly higher when compared to control group. No significant effect was observed on the plants of potato (Ansari, 2008). The effect of vermiwash was observed on okra by Ansari and Kumar (2010). It was observed that the yield of Okra increased to 64.27% as compared to control group. The vermiwash may contain cytokinins, auxin, amino acids and vitamins, enzymes possibly derived from microbes associated with earthworms.

Conclusion

In the present study, the effect of vermiwash was observed on the brinjal plant and it was found that the results obtained were little bit higher compared to vermicompost. However, it can be concluded from the present research work that the vermiwash proves to be an effective biofertilizer which contributes to the growth of plants when sprayed directly as well as mixed with the soil. It was also observed that the plants treated with vermiwash were disease resistant and no worms were seen on the leaves and other parts of plants. Vermiwash revealed the potential application in sustainable development of agriculture with respect to its origin, cost effectiveness, easy availability, time saving, reproducibility, reliability and eco-friendly.

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