

Original Research Article

Influence of Vermiwash on Germination and Growth Parameters of Seedlings of Green gram (*Vigna radiata* L.) and Black gram (*Vigna mungo* L.)

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ABSTRACT

Sustainable agriculture has become important way in the present time related to soil pollution and degradation. The rapidly use of organic manures and biofertilizers is one of the most important practices in the field of agriculture. Vermiwash is a liquid organic biofertilizer. The present study deals with the influence of vermiwash on the seed germination and seedling characters of *Vigna radiata* and *Vigna mungo*. Vermiwash at three different concentrations of 10%, 20% & 30% was used along with Gibberellic acid at 100 μ g/ml to compare its growth promoting effects and distilled water used as control. The seeds were treated with various test solutions and germination percentage and seedling characters studied. This study revealed that vermiwash at lower concentration was effective in bringing about seed germination and growth of seedling characters. The germination percentage was increasing as concentration of vermiwash increases in *Vigna radiata* and in *Vigna mungo* all seeds showed 100% germination. The seedling growth parameters such as hypocotyls length increases in *Vigna radiata* compare to *Vigna mungo* in 10%, 20% & 30% vermiwash. Radical length was more in *Vigna mungo* compared to *Vigna radiata*.

Keywords

Vermiwash,
Biofertilizer,
Hypocotyls,
Radical,
Germination

Introduction

Due to increasing population and development of human civilization, industrialization increased the problem of environmental degradation. The rapidly use of chemical fertilizer & pesticide destroyed the fertility of soil & 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 & disease and environmental pollution (Ansari and Ismail,

2001). Sustainable agriculture has become important in the present day time owing to pollution and soil degradation. The use of organic manures and fertilizers which are of biological origin is one of the important practices in this form of agriculture. Lots of scientists making efforts to find out manures and fertilizers that are eco-friendly and biodegradable. 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.

The role of earthworms in the soil formation and soil fertility has thus been well documented and recognized. An approach towards good soil, with an emphasis on the role of soil inhabitants like earthworms, in soil fertility, is very important in maintaining the ecosystem. Vermicomposting is a novel eco-friendly and cost effective technology of decomposing organic matter and producing organic manure that was the best in all aspects including the nutrient level. Application of vermicompost favourably affects soil P^H, microbial population and soil enzyme activities (Shweta and Singh, 2006). The advantages of using vermicompost have been reported in the studies of Lalitha *et al.*, (2000) and Ansari, (2008 a and b) in a *A. esculentus*. Some growth controlling factors are naturally present in the plants. Manufacturing and production of synthetic phytohormones is not economically feasible and the optimum conditions under which they can function efficiently is also difficult to ascertain (Ismail, 2005). Artificial growth regulators can cause some health and environmental problems because of their low biodegradability.

There are several organic fertilizers in the form of vermicompost, farmyard manure, press mud, coir pith compost that have been applied producing phenomenal increase in yield and quality. In recent years the use of liquid fertilizers given in the form of foliar sprays has gained importance. Vermiwash obtained from earthworm bed contains many growth regulating substances (Nielson, 1965). Vermiwash is a liquid that is collected after the passage of water through 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 solubilising bacteria. Kale (1998) reported that vermiwash as foliar spray was effective in increasing the growth and yield response of *Anthurium*. Hatti *et al.* (2010) reported that the seedling of *Vigna mungo*, *Vigna radiata*, *Sesamum indicum*, resulted in increase of growth of parameters like 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. There are reports by Lalitha *et al.*, (2000), Zambare *et al.* (2007), Ansari and Ismail (2001) and Shivasubramanian and Ganeshkumar (2004) for the effectiveness of vermiwash as a biofertilizer helping in organic farming.

Materials and Methods

The plants used in the present study are *Vigna radiata* and *Vigna mungo* belonging to the same family Leguminosae (Fabaceae) and sub-family Papilionaceae which is commonly used as pulse crop. In India pulse crops are considered as Kharif crops. Authentic samples of seed procured from Maharashtra State Seeds Corporation LTD, Akola were used to raise plants for the experiments. The experimental material was *Vigna radiata* and *Vigna mungo* for germination studies.

Vermiwash unit: 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. Vermiwash unit was set up in a plastic container of 15 liter capacity. A hole was made at the bottom of barrel. A layer of bricks 2-3cm breadth was placed at the bottom of the container. A layer of sand of 2-3cm was maintained above this layer. Followed by cow dung layer 3-4 cm and then soil was added above this layer about 2-3 cm. Then added 50 numbers of earthworms *Eisenia foetida* (Savigny,1826) in the container. Final layer was kitchen waste as a food for earthworms. 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 during throughout the experiment. Every day water was poured in the saline bottle. After 20 days the liquid vermin wash was produced in the bucket.

Vermiwash collection: After 20 days the liquid vermiwash was collected in the vessel which was kept below the barrel. Vermiwash stored in the bottle for further use.

Preparation of GA3 and Vermiwash

Gibberellic acid (GA3): Gibberellic acid for the experiment was prepared as a 1000 µg/ml stock solution. For this 1 gm of gibberellic acid was dissolved in 1 litre of water. Gibberellic acid is insoluble in water so it was first dissolved in 2 ml of ethyl alcohol and then made up to 1000ml by adding distilled water to prepare a 1000 µg/ml stock solution. 100 ml of stock solution was made up to 1 litre by using distilled water and this had a concentration of GA3 at 100 g/ml.

Vermiwash Dilution: Vermiwash, a biofertilizer is produced by epigeic

earthworm (*Eisenia foetida*). About two litres of vermiwash was collected and used for the experiment and used in three dilutions – VW I – diluted ‘10’ times with distilled water which is a 10% concentration and VW II – diluted ‘5’ times with distilled water which is 20%, VW III – diluted ‘3’ times with distilled water which is 30% (Table 2).

Germination of seeds

To study the effect of vermiwash on germination of the seeds investigated, the seeds were allowed to germinate in the petri plates and the treatments were given as per table 2 for both the experimental seeds. After 48 hrs, germinated seeds were counted. At the end of fifth day the hypocotyl length and radical length were counted.

The effect of the treatment on the seed germination of *Vigna radiata* and *Vigna mungo* was studied by soaking the seeds in water for one set which served as the control, for other sets seeds were drenched in VW I, VW II, VW III and GA3. Petri plates with filter papers soaked with distilled water for control and others soaked in respective solutions such as GA3, VW I, VW II and VW III. After germination the petri plates were maintained at a room temperature under natural light conditions in a temperature controlled lab and periodically observed. Then the total number of seeds germinated was calculated for the control and treated plants. From this observation the percentage of germination was calculated.

Statistical analysis

The results were statistically analyzed according to standard methods. For seedling characters every treatment had ten samples analyzed for each parameter. These were randomly selected and numbered for

analyses in further experiments and to maintain uniformity. The mean, standard deviation and standard error of means was calculated for each parameter according to standard methods.

Results and Discussion

The various aspects of study such as germination percentage, hypocotyls length, radical length were done in the petriplates grown seeds of *Vigna mungo* and *Vigna radiata*. Studies were helpful to find out the influence of vermiwash on seed germination and seedling growth parameters.

As seeds gives positive responses to different concentration of vermiwash in the two plants. So it is necessary to standardize the concentration based on the crop to which it is to be used. Influence of vermiwash on germination and growth of cow pea (*Vigna unguiculata*) and Rice (*Oryza sativa*) with respect to shoot and root length, number of leaves and branches, leaf length and breadth were high (M.R. Rajan and P. Murugesan, 2012)

Germination percentage

The germination percentage was determined for the control, GA, VW I, VW II and VW III.

It was found to be maximum in seeds that were treated with VW I & VW II and was minimum in the control for the Green gram seeds (*Vigna radiata*). The GA3 treated seeds had a moderate percentage of germination and those treated with Vermiwash III showed a germination percentage that was a higher than that of GA3.

For the Black gram seeds (*Vigna mungo*), it was found that all the treatments showed 100% germination such as in control, GA3,

VW I, VW II, &VW III. All seeds shown positive response.

$$\text{Germination Percentage} = \frac{NG}{NT} \times 100$$

NT = Number of seed treated

NG = Number of seed germinated

Parameters of seedlings

The seedling characters observed were hypocotyls length and radical length. Hypocotyl length was observed to be maximum in vermiwash III followed by Vermiwash II, Vermiwash I then GA3 and minimum in control plants in both the experimental materials. The extent of response was high for *Vigna mungo* in control & GA3 compared to *Vigna radiata* for hypocotyls length. But in all vermiwash preparation such as in VW I, VW II VW III was high in *Vigna radiata* than *Vigna mungo*.

Radical length was maximum in Vermiwash – III followed by Vermiwash – II, Vermiwash- I then GA3 and minimum in control plants in both the experimental materials (Table 3). The extent of response was high for *Vigna mungo* compared to *Vigna radiata*.

The present study that has been conducted on two pulse crops to determine the potential of vermiwash in bringing about seed germination and seedling growth parameters in comparison with a growth promoter like Giberellic acid has revealed that Vermiwash at a higher dilution is able to bring about increased germination percentage and enhanced seedling growth parameters in both the plants studied. The degree of response of the two plants has varied and this could be related to the physiology of the plants under consideration

and the concentration of vermiwash needs to be standardized to suit the plant to which it is applied. The results obtained in the present study have corroborated the results of Shivasubramanian and Ganeshkumar (2004) on marigold and those of Lalitha et al

(2000) and Ansari and Sukhraj (2010) on Okra plant. The application of vermiwash on *Zea mays* plant shows increase in height, number of leaves (Mynyuchi. M.M, et al, 2013).

Table.1 Chemical composition of vermiwash

Sr no.	Parameters	Vermiwash
1	P ^H	7.18
2	Electrical Conductivity (M Ū)	3.26
3	Calcium (meq /L)	300.23
4	Magnesium (meq/L)	65.93
5	Total Nitrogen (%)	0.346
6	Total Carbon (%)	5.54
7	Available Phosphorus (%)	0.46
8	Potassium (mgm%)	39.50

Table.2 Showing the various concentrations of vermiwash and plant growth regulators (PGRS)

Sr no.	Treatment	PGRS	Concentration
1.	Control	-	10 ml distilled water
2.	Gibberellic acid (100 µg/ml)	GA3	GA3 1 ml + 9 ml D/W
3.	Vermiwash – I (10%)	Vermiwash - I	1 ml vermiwash + 9 ml D/W
4.	Vermiwash – II (20%)	Vermiwash - II	2 ml vermiwash + 8 ml D/W
5.	Vermiwash – III (30%)	Vermiwash - III	3 ml vermiwash + 7 ml D/W

Table.3 Effect of Vermiwash on seedling characters of *Vigna radiata* and *Vigna mungo*

Sr no.	Treatment	Hypocotyl length (cm) ± SE		Root length (cm) ± SE	
		<i>V. radiata</i>	<i>V. mungo</i>	<i>V. radiate</i>	<i>V. mungo</i>
1.	Control	4.25±0.43	6.12±0.37	2.82±0.81	3.62±0.62
2.	GA3	4.75±0.47	6.37±0.23	2.87±0.23	4.50±0.5
3.	Vermiwash I	7.00±0.70	6.62±0.31	3.25±0.52	5.00±1.35
4.	Vermiwash II	7.50±1.04	6.82±0.17	4.00±1.17	6.37±0.68
5.	Vermiwash III	8.17±1.27	7.12±0.42	5.37±0.37	7.50±1.70

Table.4 Percentage germination in *Vigna radiata* and *Vigna mungo* seeds

Sr no.	Seeds	Control	GA3	Vermiwash I	Vermiwash II	Vermiwash III
1.	<i>Vigna radiata</i>	20%	30%	40%	50%	70%
2.	<i>Vigna mungo</i>	100%	100%	100%	100%	100%

Figure.1 10% Vermiwash, 20% Vermiwash and 30% Vermiwash Preparation



Figure.2 Length of hypocotyls in *Vigna radiata* and *Vigna mungo*

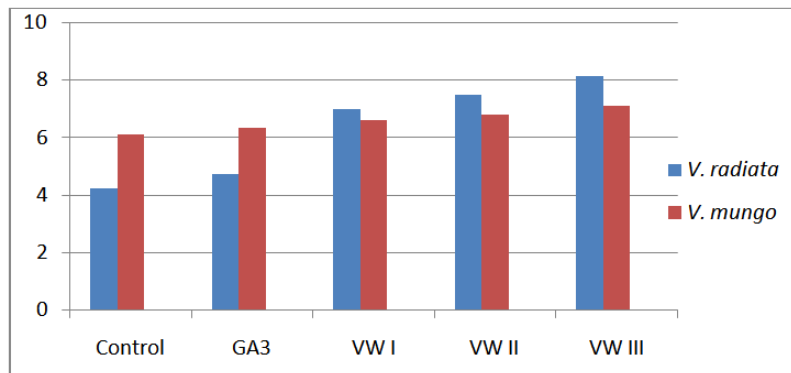


Figure.3 length of radical in *Vigna radiata* and *Vigna mungo*

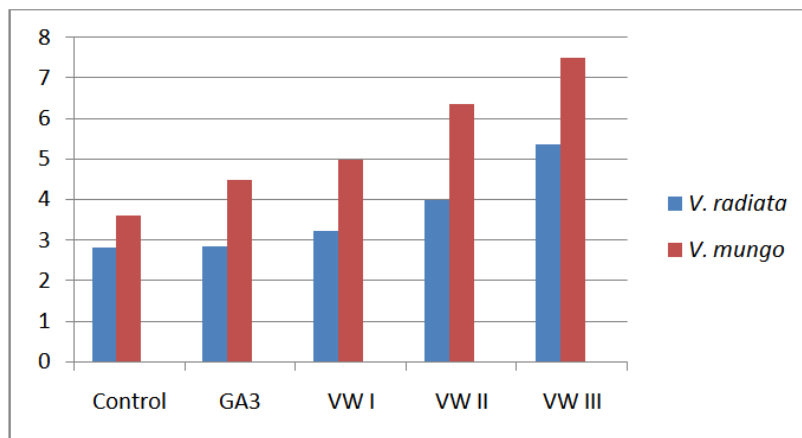


Figure.4 Percentage of germination in *Vigna radiata* and *Vigna mungo*

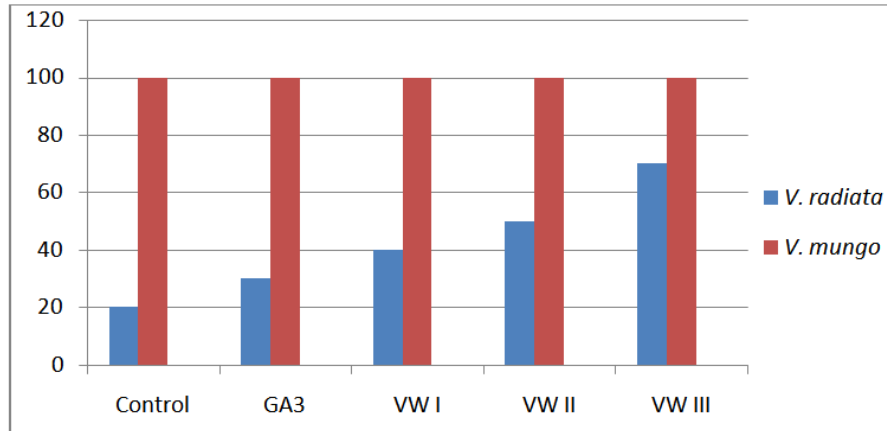


Figure.5 Overall experimental setup of growth of Seedlings of *Vigna radiata* after 5 days



Figure.6 Overall experimental setup of growth of Seedlings of *Vigna mungo* after 5 days



Figure.7 Seedlings of *Vigna radiata* after 5 days showing hypocotyls & radical length



Figure.8 Seedlings of *Vigna mungo* after 5 days showing hypocotyls & radical length



The effects can be attributed to the biofertilizer capability of Vermiwash as it possesses growth promoting effects and so it is able to mimic Gibberellic acid and in fact the present study shows that it has produced an effect that is better than gibberellic acid. This shows that vermiwash can be used as a biofertilizer to improve the germination and seedling growth parameters in pulse crop plants as in the nutrient deficient soil vermiwash is a hopeful method for sustainable agriculture using organic farming practices. Thus vermiwash can be an important liquid for organic farming with natural minerals and can save us from artificial fertilizers.

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