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Effect of Vermicompost and Vermiwash on Growth of Vegetables

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Abstract

Vermi composting is a cost-effective and eco-friendly process used to treat organic waste. Vermi compost is nutrient rich, with microbiologically-active organic amendment which results from the interactions between earthworms and micro organisms by the breakdown of organic matter. Earthworms convert the waste material into small particles by breaking in the gut and obtain the nutrients from the microbes that harbour upon them. This process increases the rate of degradation of the organic waste matter, modifies the physico-chemical properties of the matter and leads to formation of humus in which unstable waste matter is completely oxidized. Various physico-chemical and biological characteristics of soil are enhanced by amendment with vermin compost as well as it aggregates stability of soil, growth of plants, increases microbial activity and enzyme production. Research have shown that vermin compost has an effective role in improving growth and yield of different field crops, including vegetables, ornamentals, cereals and fruit crops.

Keywords: Vermicompost, vermiwash, vegetables, plants, earthworm.

Introduction

"Sustainable agriculture" can be ensured in future with the help of organic farming systems which includes various processes of biological origin such as compost and vermin compost. It is an established fact that earthworms act upon various kinds of wastes including sewage sludge, animal wastes and crop residues etc. Composting and vermin composting are appropriate technologies which convert waste to wealth. Vermi composting is increasingly becoming popular as an organic farming and solid waste management technique and it produces two vital bio fertilizers, vermin compost and vermin wash. Various species of earthworm feed on the waste and their gut act as the bioreactor where the vermin casts are produced[1]. These vermin casts are rich in soil macronutrients and micronutrients. Biological degradation of organic wastes by earthworms and microorganisms produces vermin compost. It is a dual process by which earthworms of various species derive nourishment from the microbes which are flourishing in the organic waste as well as degrade the complex organic waste into smaller particles in their gizzard, a part of their alimentary canal[2]. The end product, i.e. vermin compost is highly humified through the breakdown of the parent waste materials by earthworm and presence of microbes in addition, during the vermin composting process, a liquid substance is produced which is called vermin wash.

Various forms of organic matter can be used for vermin composting, including animal manure, wastes from manufacturing industries e.g. paper, sugar cane or cotton residues, kitchen and agricultural wastes, as well as municipal wastes of organic origin[3]. The nutritional value of the vermin compost is however dependent on its origin. Vermi composted animal manures tend to have a higher nutritional status, compared with that derived from organic municipal waste[4]. For example, vermin compost produced from cattle and pigs manure as well as food wastes increased the rate of germination, growth and flowering of a range of ornamental and vegetable seedlings compared with vermin compost from other sources[5-7].

Table-1
Examples of nutrient (%) in vermicompost, compared with farm yard manure

Nutrient*	Vermicompost	Farmyard manure
N (%)	1.6	0.5
PO (%)	0.7	0.2
KO (%)	0.8	0.5
Ca (%)	0.5	0.9
Mg (%)	0.2	0.2
Fe (ppm)	175.0	146.5
Cu (ppm)	5.0	2.8
Zn (ppm)	24.5	14.5

*These values are subject to variation depending on the type of organic waste.

Effect of Vermicompost on Vegetables

Various reports suggested that worm worked waste and their excretory products (vermin cast) can induce excellent plant growth. It is evident that it influences on growth and yield parameters improved seed germination rate, seedling growth, flowering and fruiting of major cash crops, cereals, vegetables, ornamentals etc. It is very interesting to note that the best growth response was exhibited when vermin compost constituted relatively small proportions (10%-20%) of the total

volume of the container medium. Surprisingly, greater proportions of vermicomposts in the plant growth medium have not always improved plant growth[8,9].

Furthermore when biodigested slurry and vermicompost amended soil was compared and fresh and dry matter production of cowpea was studied, it was found to be improved and its production was higher when vermicompost was applied at a rate of 10 t/ha along with recommended N, P, K compared with these fertilizers when applied alone[10].

In an experiment conducted in 1999 and 2000, commercially available vermicompost from cattle manure, food waste or recycled paper were applied in fields plots at rates of 20 t/ha and 10 t/ha and 10 t/ha and 5 t/ha respectively. It was compared with the equivalent amount of application of inorganic fertilizers and resulted in increased growth and yield of field tomatoes (*Lycopersicon esculentum*) and peppers *(Capsicum anuumgrossum*)[11].

Productivity of potato (*Solanum tuberosum*), spinach (*Spinacia oleracea*) and turnip (*Brassica campestris*) after the application of vermicompost was estimated by monitoring the soil quality and yield. The dose of vermicompost constituted 4, 5 and 6 t/ha. At the end of trial, significant improvement in the soil quality of plots after amendment with vermicompost was seen @ 6 tonnes/ha as well as overall productivity of vegetable crops was observed greater in plots treated with vermicompost @ 6 tonnes/ha[12].

In an another study on tomato plant firstly, various quantity parameters like mean stem diameter, mean plant height, yield, marketable yield, mean leaf number, total plant biomass were studied at different treatments with vermin compost {Soil (control), 15%, 30%, 45% }.Secondly various quality parameters like ascorbic acid, titrable acidity, soluble solids, insoluble solids and pH were obtained for each treatment. The 15% treatment was found to be best as percentage of germination was maximum at this treatment and also all the parameters listed above were significantly enhanced as compared to control treatments[13].

In an experiment growth of *Capsicum annum*was examined in 2011 after the application of chemical fertilizer and vermicompost. Concentrations of vermin compost applied in plots were 0, 5, 10, 15 and 20%. A number of measurements were made like height of plant, length of leaf, leaves per plant, content of chlorophyll in leaves, fresh weight, dry weight etc. Some of the parameters showed better and significant results with vermicompost application. At 20% concentrations maximum leaf chlorophyll content 2.9% was observed[14].

The impact of vermicompost on plant components, growth and biochemical changes in groundnut was analysed. High length in seedling, high amount of photosynthetic pigments such as chlorophyll-a, chlorophyll-b, Total chlorophyll and carotenoid content (0.764, 0.544, 1.313, 0.570 mg/g fr.wt) high protein content, amino acid and sugar (25.587, 7.847, and 4.970 mg/g fr. wt) were recorded in groundnut seedlings, grown in soil that had application of 200g of vermicopost[15].

In the field conditions the efficacy of vermicompost on tomato plant (*Lycopersicumesculentum*) was estimated by analyzing growth, yield and fruit quality of plant. The rate at which vermicompost was incorporated was (0, 5, 10 and 15 t ha^{-1}). Largest concentrations of vermicompost i.e. 15 t/ha significantly increased growth and yield of plant[16].

The influence of vermicompost on the germination of different vegetable crops was studied. They reported maximum germination of 96.74, 84.32 and 92.35% in okra, brinjal, chilli with the treatment of 50% vermicompost. The maximum root length of okra was 7.07, 9.13, 13.03cm and chilli was 5.80, 7.60, 10.90cm noticed in the 50% vermicompost concentration at 30, 60, 90 days exposure. The maximum shoot length was recorded in okra and chilli as 33.47, 46.58, 61.50, 29.57, 38.93 and 66.60cm in 50%vermicompostconcentration. The influence of vermicompost on branch number study revealed that in okra the maximum numbers were 4.00. 6.00, 8.00 and in chilli the maximum numbers were 11.6, 15.67, 19.67 at 50% vermicompost concentration after 30, 60 and 90 days of exposure respectively[17].

The effect of cow manure vermicompost and inorganic fertilizers on the vegetable growth and fruits of tomato plants. An air dried sandy loam soil was mixed with five rates of vermicompost equivalent to (control), 5, 10, 15 and 20 t $ha^{-1}$and three rates of NPK fertilizer equivalent to 50% (N-P-K= 69-16-35kg ha^{-1}), 100% (N-P-K= 137-32-70kg ha^{-1}) and 200%(N-P-K= 274-64-140kg ha^{-1}). The data revealed that shoot length, number of leaves, dry matter, weight of shoots and roots, fruit number and fruit weight were influenced significantly ($P< 0.05$) by the application of vermicompost and NPK fertilizer in the growth media. The highest dose of vermicompost of 20 t ha^{-1} increased dry weight of shoot 52 folds and root of 115 folds, number of fruit(s)/plant of six folds and mean fruit weight of 29 folds while the highest rate NPK fertilizer of 200% increased dry weight of shoot of 35 folds and root of 80 folds, number of fruits(s)/plant of 4 folds and mean fruit weight of 18 folds over the control treatment. The growth performance of tomato was better in the vermicompost amended soil pots than the plant grown in the inorganic fertilizer amended soil[18].

Effect of Vermiwash on Vegetables

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 contains nitrogen as nitrogenous excretory product and growth promoting hormones and essential enzymes and infuses resistance in plants. It is applied as foliar spray. This is

transported to the leaf, shoots and other parts of the plants in the natural ecosystem. It contains various enzymes cocktail of protease, amylase, unease and phosphatase. These are beneficial for growth and development of plant and stimulate the yield and productivity of crops and also microbial study of vermiwash found that nitrogen fixing bacteria like *Azotobacter, Agrobacterium* and *Rhizobium* and some phosphate solublizing bacteria are also found in vermiwash.

Table-2
Concentration of different nutrients in one litre of vermiwash

Organic Carbon	0.001%
Potassium	423.5 ppm
Sodium	316.88 ppm
Calcium	133.6 ppm
Magnesium	86.73 ppm
Copper	0.04 ppm
Zinc	0.99 ppm

Vermiwash has growth promoting effect on crinckle red variety of *Anduriumandreanum*[19]. Its positive effect on plant growth of black gram was also reported in some studies.

Seedling of *Vignamunga, Vigna radiate, Sesamumindicum*, resulted in increase of growth parameters like the root length, shoot length, number of twigs and leaves and total biomass of the plant after spraying the vermiwash of *Perionyx excavate*[20].

Vermiwash exhibited growth promoting effects on the exo-morphological 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 *Abelmoschusesculentus*[21]. Among the various foliar treatments used in the study, 15% vermiwash showed growth enhancing effects followed by 10% vermiwash, Gibberelic acid (100 g/ml) and Naphthalene acetic acid (100 g/ml). Maximum root length and plant biomass was recorded in 15% vermiwash. These results clearly indicate that vermiwash can be exploited as a potent biofertiliser and foliar spray.

Effect of vermiwash on the growth and development of leaves and stem of tomato plants was studied[22]. Vermiwash when mixed with vermicompost increased the shoot length to 19.61±0.18cm as compared to control 17.92±0.21 cm, when vermiwash was directly sprayed on the plants of tomato the length of shoot was recorded to be 19.72±0.30 cm which was higher as compared to control group17.92±0.21 cm. It can be concluded that the growth of tomato plants showed much positive results when grown in vermicompost. However the results were apparent when the plants were treated with vermiwash. Hence, vermiwash proves to be an effective fertilizer which contributes the growth of plants when sprayed directly as well as mixed with a definite ratio of vermicompost.
A study in 2014 to evaluate the effect of vermiwash on growth and productivity of brinjal plants was conducted[23]. Physico-chemical properties of the soil in both control and experimental plots were studied and interrupted with results. The results revealed that vermiwash spray enhanced the growth parameters (plant height and number of leaves) and yield parameters (number of flowers and fruits per plant). Flowering and fruiting ratio was significantly increased in experimental plots. From the results it is seen that extracts from earthworms offer a valuable resource which could be effectively exploited for increasing the production of brinjal.

Conclusion

With the global trend moving towards the production of organic food crops, organic waste material processed by the naturally occurring earthworm should be used to produce vermicompost which will supply nutrients and other soil stimulants for plant growth and improve soil quality. Vermiculture provides the best answer for ecological agriculture, which is syn-onymous with "sustainable agriculture".

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