

## Nutrient Analysis and the Effects of Green Gram Waste Vermicompost and Vermicasts on the Growth Parameters of Radish Plant

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### Abstract

The levels of soil parameters such as pH, EC, macro (N, P and K) and micronutrients (Fe, Mn, Zn and Cu) present in the samples of partly decomposed, vermicompost and vermicasts of green gram wastes were determined. No change was noticed in the pH of partly decomposed green gram waste (DGW) while vermicasts production. But the samples of vermicompost showed lesser pH (7.6) over DGW or vermicasts. The EC values of DGW showed relatively more when compared to vermicompost or vermicasts which indicate that the soluble salt level was reduced during vermicomposting. The earthworm, while vermicomposting slightly increased the levels of P, Zn and Cu and drastically decreased the levels of K and Mn of DGW. Though a differential effect was noticed in the growth parameters of radish plants raised in different PSR of partly decomposed, vermicompost and vermicasts, the plants raised in vermicasts showed relatively lesser values than the vermicompost or DGW.

**Key words :** Green gram waste, Vermicast, Vermicompost, Nutrient analysis, Radish plant.

Being rich in macro and micronutrients, the vermicompost/vermicast has been found an ideal organic manure enhancing biomass production of a number of crops (1—3). It is believed that earthworms release certain metabolites, vitamins and similar substances into the soil thereby improves the physical, chemical and biological properties of soil (4). Although importance of vermicompost/vermicast in agriculture, horticulture, waste management and soil conservation has been well documented (5—7), no works have been carried out with regard to the utilization of green gram waste in the field of vermiculture or agriculture. To utilize the bulk production of green gram waste during harvest in the cauvery delta region for vermicompost production to achieve the goal of replacing the chemical fertilizers to promote pollution free nutrient rich crop production for human welfare, the present work as an addendum to our previous report (8) was planned to ascertain the quality of vermicompost/vermicasts obtained from the same through micro and macro nutrients analysis along with pot cultivation of radish plant.

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### Methods

#### *Collection of Vermicompost and Vermicasts*

At the end of cocoon production study done by Jayaseelan and Bakthavathsalam (8) using different PSR of partly DGW with *Eudrilus eugeniae*, the media used by earthworms were collected separately as vermicompost and stored in polythene bags for macro and micronutrients analysis and cultivation of radish plant. For vermicasts collection, three earthen pots were taken and to each 4 liters of partly DGW was filled. Thirty six adult earthworms were introduced into each pot. The vermicasts were collected daily after three days of exposure from the upper surface of the medium until all the earthworms released their vermicasts and stored in polythene bag separately. At the end of 20 days of exposure, vermicast was not found on the surface of any substrate medium.

#### *Macro and Micronutrients Analysis*

The levels of pH and electrical conductivity (EC) were measured in the samples of partly DGW (before

vermicomposting), vermicompost and vermicasts (after vermicomposting by *Eudrilus eugeniae*). Macronutrients such as nitrogen (N), phosphorus (P) and potassium (K) and micronutrients such as zinc (Zn), iron (Fe), copper (Cu) and manganese (Mn) were also estimated in the above samples at Soil Testing Laboratory, Soil Research Institute, Aduthurai. The contents of macro and micronutrients were expressed as ppm.

#### *Effect of Vermicompost and Vermicast on the Growth of Radish Plant*

Twenty pots with size 22 cm diameter and 23 cm height were taken and to each, 5 liters of 100, 75, 50, 25 and 10 PSR of partly DGW and vermicompost were transferred separately in duplicate. Another 12 circular pots with same size were taken and to each 5 liters of dry fresh soil was transferred. Two sets of six doses (5, 10, 15, 20, 25 and 30%) of green gram waste vermicasts were selected and added to the pot soil. Control experiment in duplicate was also made along with these studies.

Radish seeds were purchased from the local seed farm at Kumbakonam. At equal distance three seeds were placed in each pot at 2.5 cm deep and sufficient water was poured in all the pots for proper germination. The experimental pots were kept at open terrace for direct sunlight. The pots were regularly poured with sufficient water to ensure proper growth until the plants get harvested. Care was taken to see that the plants growing in the pots must be protected from predation, if any. Ten days after seed sowing, all plants in the pots were counted their leaves. Similar counting was also made regularly at 10-day intervals in all the plants. At the end of 40 days, all plants were uprooted and measured their leaves and root weight.

Statistical comparisons were made in macro and micronutrient levels between the samples of partly DGW, vermicompost and vermicasts.

### **Results and Discussion**

#### *Analysis of Macro and Micronutrients in Green Gram Wastes*

The levels of soil parameters such as pH, EC, macronutrients (N, P and K) and micro-nutrients (Fe,

**Table 1.** Values showing the levels of pH, EC (ds/m), macro and micronutrients obtained from the samples of partly DGW and vermicompost and vermicasts of green gram wastes after using them by *Eudrilus eugeniae* under laboratory condition. \*Values are mean  $\pm$  SD of six samples.

Parameters	Partly DGW	Vermicompost	Vermicasts*
<b>Sample Nature</b>			
pH	7.8	7.6	7.80 $\pm$ 0.05
EC	1.5	1.1	0.98 $\pm$ 0.96
<b>Macronutrients (ppm)</b>			
N	142.8	145.6	93.8 $\pm$ 13.4
P	59.8	63.1	62.6 $\pm$ 0.8
K	662.5	383.0	249.3 $\pm$ 29.9
<b>Micronutrients (ppm)</b>			
Fe	28.1	29.2	24.9 $\pm$ 2.1
Mn	14.2	12.5	12.7 $\pm$ 0.9
Zn	1.5	1.9	1.6 $\pm$ 0.2
Cu	1.8	2.4	2.3 $\pm$ 0.2

Mn, Zn and Cu) present in the samples of partly DGW (before vermicomposting), vermicompost (after vermicomposting by *Eudrilus eugeniae* for 35 days) and vermicasts (collected after 3—20 days of earthworm exposure) of green gram waste are given in Table 1. The pH values measured in the samples of partly DGW and vermicasts showed no change but are basic in nature (pH 7.8). But the sample of vermicompost showed relatively a low pH (7.6) over raw DGW or vermicasts. The levels of EC measured in the samples of partly DGW showed relatively more value (1.5) than the samples of vermicompost or vermicasts which indicates that the soluble salt level was reduced during vermicomposting as revealed by its lower pH value in the vermicompost sample. The availability of several plant nutrients and other elements present in any soil depends upon the pH value of the organic manure. In the present analysis though there are changes in pH during vermicomposting but their pH level was relatively more as reported by Brady (9). Hence it could be concluded that the observed pH in all the green gram samples are not safe for the plants to get available free nutrients for their better growth. However the cultivation study of radish plants with vermicompost revealed a better results over control plants due to the presence of higher amount of nitro-

**Table 2.** Values showing the growth parameters of radish plants raised in pots using different PSR of partly DGW and vermicompost after 40 days. Values are mean  $\pm$  SD of six plants. Upper and lower row values in 10, 25, 50, 75 and 100 PSR indicate the plants raised in partly DGW and vermicompost respectively. \*Upper and lower row values indicate earthworm unexposed soil and earth worm exposed soil respectively.

PSR	Total leaves	Leaves weight (g)	Tap root weight (g)	Plant weight (g)	Top root length (cm)	Tap root perimeter (cm)
*0	7.7 $\pm$ 1.3	3.2 $\pm$ 1.2	2.5 $\pm$ 1.8	5.7 $\pm$ 5.1	6.6 $\pm$ 2.8	2.5 $\pm$ 1.4
	8.0 $\pm$ 0.8	3.2 $\pm$ 0.5	2.4 $\pm$ 0.2	5.6 $\pm$ 0.6	6.4 $\pm$ 1.7	1.8 $\pm$ 0.3
10	9.7 $\pm$ 1.5	5.8 $\pm$ 1.8	5.3 $\pm$ 3.1	11.1 $\pm$ 3.6	8.8 $\pm$ 2.8	3.8 $\pm$ 1.5
	9.8 $\pm$ 1.4	11.0 $\pm$ 0.6	16.5 $\pm$ 9.7	27.6 $\pm$ 12.3	13.2 $\pm$ 1.9	5.6 $\pm$ 1.8
25	14.0 $\pm$ 1.7	11.9 $\pm$ 3.5	13.8 $\pm$ 12.0	25.7 $\pm$ 12.8	11.0 $\pm$ 2.3	5.0 $\pm$ 1.8
	14.9 $\pm$ 1.6	21.6 $\pm$ 3.8	45.1 $\pm$ 12.0	66.6 $\pm$ 13.0	16.7 $\pm$ 1.9	7.0 $\pm$ 0.9
50	15.2 $\pm$ 2.0	19.7 $\pm$ 4.9	46.9 $\pm$ 22.1	66.6 $\pm$ 14.6	16.3 $\pm$ 5.2	6.9 $\pm$ 3.0
	16.7 $\pm$ 1.1	29.9 $\pm$ 6.4	57.7 $\pm$ 30.3	87.6 $\pm$ 33.9	17.6 $\pm$ 2.3	9.1 $\pm$ 1.4
75	15.2 $\pm$ 1.7	39.2 $\pm$ 16.2	60.5 $\pm$ 5.2	99.8 $\pm$ 49.0	18.3 $\pm$ 4.7	9.5 $\pm$ 2.5
	16.5 $\pm$ 1.1	67.9 $\pm$ 30.0	127.7 $\pm$ 47.9	195.6 $\pm$ 73.8	20.9 $\pm$ 3.3	11.2 $\pm$ 1.4
100	16.0 $\pm$ 1.5	52.6 $\pm$ 14.6	86.8 $\pm$ 23.8	139.4 $\pm$ 29.5	18.3 $\pm$ 3.3	10.7 $\pm$ 0.9
	18.0 $\pm$ 1.8	59.7 $\pm$ 24.1	114.0 $\pm$ 45.3	172.8 $\pm$ 68.8	21.2 $\pm$ 3.3	10.9 $\pm$ 1.5

gen in the medium. The high pH value observed in DGW supported the views that the nitrogen level is lost during storage as suggested by Haimi and Huhta (10).

Of the three macronutrients (N, P and K) and four micronutrients (Fe, Mn, Zn and Cu) analyzed in partly DGW, vermicompost and vermicasts, the levels of K in macronutrients and Fe in micronutrients were relatively high when compared to other macro and micronutrients. The partly DGW, while vermicomposting, slightly improved its level in P, Zn and Cu and decreased its level in K and Mn. This changes was not in conformation with the reported results of increased levels of K (11—13) and K and Mn (14) due to the effective action of earthworms through enhanced microbial activity on waste material during vermicomposting. From these results, it could be inferred that the waste is fully processed by earthworms as it was revealed by drastic change in its macro and micro-nutrient levels and the improved weight gain observed in the adult earthworms exposed to green gram waste for 5 weeks.

#### *Effect of Vermicompost and Vermicasts on the Growth of Radish Plant*

Mean values of total leaves, leaves weight, tap root weight, total plant weight, tap root length and tap root perimeter of radish plants raised in pots using different PSR (0, 10, 25, 50, 75 and 100) of partly

DGW and vermicompost are given in Table 2 and the respective value for 5, 10, 15, 20, 25 and 30 PSR of vermicasts are given in Table 3. The plants raised in soil alone showed poor growth over other doses of partly DGW, vermicompost and vermicasts studied. The results revealed a differential effect on all the growth parameters of radish plant raised in the above media. Plants that are raised in vermicasts showed relatively lesser values in all the parameters over the plants raised in vermicompost or partly DGW. Of the weight measurements of leaves and roots studied, the values of root weight obtained in different PSR were relatively high when compared to leaves weight. Further, the plants raised in higher PSR (75 and 100) produced relatively higher root weight over other PSR. The growth results proved that the application of vermicompost has a positive role on the growth parameters of radish plants. This observation falls in line with many reports made in other plants with vermicomposts obtained from different sources. Kale and Bano (15) found that the vegetative growth of plants was influenced by *Edudrilus eugeniae* worm cast in a better way than chemical fertilizers. Line (16) reported that vermicomposted mixture of wood waste and sea star waste showed an excellent growth of tomatoes and lettuces. Arulmurugan (17) has studied the effect of vermicompost on the growth yield, protein and oil content of soybean and recorded an increase in plant height, root length, root volumes, number of seeds per plant, protein and oil content of seeds

**Table 3.** Values showing the growth parameters of radish plants raised in pots using different PSR of vermicasts obtained from green gram waste after 40 days. Values are mean  $\pm$  SD of six plants.

PSR	Total leaves	Leaves weight (g)	Tap root weight (g)	Plant weight (g)	Tap root length (cm)	Tap root perimeter (cm)
5	7.6 $\pm$ 0.5	4.7 $\pm$ 1.2	3.2 $\pm$ 2.3	7.9 $\pm$ 4.5	6.8 $\pm$ 1.5	2.4 $\pm$ 1.3
10	8.6 $\pm$ 1.2	5.2 $\pm$ 2.1	3.4 $\pm$ 2.1	8.6 $\pm$ 4.1	7.0 $\pm$ 1.5	2.9 $\pm$ 1.7
15	9.0 $\pm$ 1.2	7.6 $\pm$ 2.1	7.0 $\pm$ 3.3	14.6 $\pm$ 3.9	10.4 $\pm$ 1.8	3.8 $\pm$ 1.8
20	9.0 $\pm$ 1.2	9.7 $\pm$ 2.8	15.5 $\pm$ 3.0	25.2 $\pm$ 2.4	11.0 $\pm$ 2.0	4.7 $\pm$ 1.9
25	9.2 $\pm$ 1.3	11.2 $\pm$ 4.5	17.0 $\pm$ 8.0	28.1 $\pm$ 7.1	11.3 $\pm$ 2.1	4.8 $\pm$ 2.0
30	10.0 $\pm$ 1.3	11.4 $\pm$ 0.8	18.0 $\pm$ 3.1	28.3 $\pm$ 3.8	12.5 $\pm$ 2.3	5.3 $\pm$ 2.0

together with increased uptake of NPK by plants. Vadiraj et al. (18) noticed pronounced influence of vermicompost on the growth and yield of turmeric plant. Uthayakumar and Bakthavathsalam (14) has also noticed an excellent improvement in the production of black gram cultivated in vermicompost obtained from vegetable market waste over the plants cultivated in ordinary soil. Ramalingam (13) has studied the differential effect of organic manures (cattle dung, farm yard manure and pressmud) and vermicomposts (obtained from farmwaste + press mud, water hyacinth + press mud and water hyacinth + press mud slurry) on the growth parameters of tomato for 60 days from transplantation and found a many fold increase in the growth parameters of vermicomposts treated plants over organic manure treated plants. Senapati (19) reported that the emergence of tomato seedling in vermicompost is much better than in recommended commercial potting compost. Madhukeshwara et al. (20) also reported that the vermicompost increased the germination efficiency and growth of tomato and suggested that vermicompost can be used as an ideal and more economical organic substitute for raising healthy nurseries which is constraint before transplantation in the field. However, the present result is not in agreement with the reported results of Bakthavathsalam and Geetha (21) and Subramaniyan (22) using the same plant but cultivated in different organic wastes such as paddy chaff, weed plants materials and paddy straw wastes.

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