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Vermicompost as a soil supplement to improve growth and yield of *Amaranthus* species

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Abstract: The present study aims at assessing the efficacy of vermicompost produced from organic waste over chemical fertilizer by applying it to *Amaranthus* species. Estimation of vermicompost composition revealed, 120.5ppm of nitrogen; 18.39ppm of available phosphorous and 50.59ppm of available potassium. Assessment on the growth of plant based on their physical parameters on the whole, on 30 DAG, revealed that vermicompost produced best results over chemical fertilizer and control. Net production of 4 kg of *Amaranthus* / plot (8.25 sq.ft. / 32 days) was obtained with vermicompost, while only 2.5 kg/plot with chemical fertilizer. While, good survival rate (96%) was observed with excess application of vermicompost on *Amaranthus plant*, low % survival (16%) was seen with excess application of chemical fertilizer. Biochemical analysis revealed greater values in plant tissues with use of vermicompost, over chemical fertilizer and control. Similar is the case with % nitrogen content; phosphorous content and potassium content of plant tissues. In terms of % of organic matter/ gram of soil when applied for plant cultivation and percentage of available nitrogen in soil, it was greater for vermicompost than chemical fertilizer and control. Humic materials and other plant growth-influencing substances, such as plant growth hormones, produced by microorganisms during vermicomposting,might have been responsible for the increased *Amaranthus* growth and yield.

Key words: Organic waste - vermicompost -growth - physical parameters - biochemical parameters - *Amaranthus* species

INTRODUCTION

Rapid growth of population and industrialization in total has resulted in increased environmental pollution[1]. Among the various categories of pollutants, solid waste-human and animal excreta, domestic, industrial and commercial waste- contribute a major share towards environmental degradation[2]. While the recyclable components in solid waste range from 13-20%, the compostable material about 80-85% [3]. Unscientific and indiscriminate disposal of solid waste is a matter of serious health concern[4]. Immediate actions are therefore warranted for proper management of urban solid waste[5].Under these circumstances there is an immediate need for improved technologies for reduction in generation of solid waste and improved technology for recycling and reuse Further, it is very important to adopt the most economically viable method for solid waste disposal[3]

Earthworms can process household garbage, city refuse, sewage, sludge and waste from wool, paper and food industries[1]. Organic farming conserves soil fertility and contains soil erosion [6]

Thus, the present study aims at producing vermicompost, at house level,from organic waste ; assessing its efficacy over chemical fertilizer by applying it to *Amaranthus* species- commonly used greens as food material.

MATERIAL AND METHODS

Locally available, mixed species of earthworms - *Lampito mauritii, Octochaetha thurstoni, Octochaetona serrata, Perionyx excavatus* - were used for this study.

Vermibin Preparation: An empty cement tank of size 60cm x30cm x 30cm was used. It was filled with gravel to about 5cms, then with sand to about 3 cms; then with loamy soil to about 12cm To this about 200 earthworms (mixed species) were inoculated. Cow dung were scattered on top and covered with hay, watered daily and maintained for 31 days.

Organic waste collected, from local houses, and preweighed was introduced into the vermibin after 31 days of vermibin preparation. Organic waste was added continuously on consecutive days till 45th day, upto 5cms. Watering was done to maintain the moisture level and the waste was turned over with a pitchfork without disturbing the vermibed at the bottom. As the compost was getting ready the change of refuse into a

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spongy, sweet smelling dark brown compost was noticeable. Watering was stopped on the 42^{nd} day of last application of refuse. 45 days after the last application of the refuse the compost was ready for the harvest.

Vermicompost Harvesting: The compost was carefully taken with spade without disturbing the bed and heaped in bright sunlight, forcing the earthworms to move to the lower layers. After collecting the earthworms, the compost was then sieved through a 2-2.5mm sieve, weighed and packed in polythene bags to retain moisture.

Estimation of Vermicompost Composition: The constituents like available nitrogen[7], available phosphorous[8] and available potassium[9] in the vermicompost were estimated.

Field Experiments:

Plot Preparation: A plot of dimension 80 inches x 45 inches was measured and selected. Soil tilling was done for proper aeration and water penetration. Plot was then watered uniformly and left for a day. On the next day the plot was divided into 3 equal rows of dimension 45 x 26.5 inches. To avoid seepage and leaching of chemical fertilizer and vermicompost manure in between the plots a polythene sheet filled with small pieces of bricks was placed to the depth of 15 cms. In addition, a superficial brick boundary was also made to distinguish the plots. The plot was watered and left undisturbed for a day.

Plant Selection and Seed Sowing: To test the efficacy of organic manure upon plant growth, *Amaranthus* species was chosen as the candidate plant based on the following characteristics of the plant : short term variety, easily procurable seeds ; higher germination capacity and higher flowering capacity.

Seeds of *Amaranthus* species were obtained from TNASIC, Chennai, Tamil Nadu. 225 seeds of uniform size and weight were selected for sowing. 75 seeds were sown in each plot maintaining equal distance between the seeds and water was sprinkled evenly. Plots were labeled as I, II & III. Of these, plot I was kept as control, while chemical fertilizer was used in plot II and vermicompost in plot III.

Application of Manure: After germination of seeds in all the three plots, while 200gms of prepared vermicompost was applied to plot III, recommended amount (200gms) of chemical fertilizer (SAIC-Trade name) with composition of N-16%, P-17%, K-17% (Source- TNASIC) were applied to plot II and plot I was left as control for comparison

Growth Studies:

Physical Parameters: The average height of the plant, average shoot length, average number of branches, average number of leaves, average leaf length, average number of flowers were noted based on 15 random samples from each plot, once in 3 days from 3 to 30 DAG (Days after germination). At the end of 30 DAG, number of seeds were calculated for 15 random samples from each plot. 15 plants were uprooted from each of plot, on the 32^{nd} day and the length of the roots were measured.

Chemical Parameters: Chlorophyll A, B, total chlorophyll and carotenoids from fresh leaves, total sugar, non-reducing sugar and reducing sugar from plant extract were estimated[10]. Plant tissue was analysed for nitrogen, phosphorous and potassium content

Soil Analysis: Soil samples were taken from each plot on 9^{th}, 21^{st}, 27^{th}, and 30^{th} DAG and the respective samples of DAG were pooled; 4 such pooled samples were taken and the average value was calculated for each plot. The organic matter content in soil was estimated from the organic carbon determined by titrimetric determination[11] and available nitrogen in the soil by using alkaline potassium permanganate method[7].

Impact of Excess Application of Vermicompost over Chemical Fertilizer: Separate plots plot IV and V were used which were of the same dimension as earlier plots used. 50 seeds were sown and watered as for other plots. In plot IV, 350 gms of vermicompost was applied and in plot V, 350 gms of chemical fertilizer was applied. The survival rates of plants were observed on 8^{th}, 15^{th}, and 18^{th} DAE (Days after exposure) for both plots IV and V.

Net Production Estimation: At the end of 32^{nd} DAG, plants of all the three plots (I, II, III) were harvested and weighed separately.

RESULTS AND DISCUSSION

With an input of 130 kg of organic waste, 52 kg of vermicompost could be produced (Table 1). In total, 2.5 fold reduction in the quantum of organic matter could be achieved using this method of vermicomposting. As evident from Table 2, the available nitrogen was estimated to be 120.5, phosphorous to be 18.39 and potassium to be 50.59 ppm, in the vermicompost. Positive influence on the growth of *Amaranthus* plant (Tables 3 -7, 9 &10) could be seen in the present study by using

Table 1: Vermicompost production

Total input of organic waste in Vermibin (Kg)	Total output of vermicompost (Kg)
130	52

Table 2 : Analysis of vermicompost

Available Nitrogen	120.5 ppm
Available Phosphorous	18.383 ppm
Available potassium	50.59ppm

Table 3 : Average height (in cms - Mean of 15 values) of plants

Category	3 DAG	6DAG	9DAG	12DAG	15DAG	18DAG	21DAG	24DAG	27DAG	30DAG
Plot I	4.19±0.05	10.2±0.04	16.4±0.1	21.0±0.6	31.04±0.5	39.30±0.6	44.5±0.1	46.8±0.2	49.2±0.01	51.76±0.01
Plot II	4.23±0.01	13.24±0.01	16.0±0.2	20.36±0.5	29.2±0.04	34.07±0.6	45.2±0.1	49.2±0.7	59.08±0.01	64.93±0.02
Plot III	4.79±0.01	17.0±0.2	23.1±0.01	28.34±0.6	41.35±0.1	46.12±0.001	55.21±0.01	68.13±0.001	74.0±0.06	82.11±0.1

± SEM (standard error of mean)
Plot I –control ; Plot II-Chemical fertilizer applied ; Plot III – vermicompost applied
DAG - days after germination

Table 4: Average shoot length (in cms - mean of 15 values) of plants

Category	3 DAG	6DAG	9DAG	12DAG	15DAG	18DAG	21DAG	24DAG	27DAG	30DAG
Plot I	3.12±0.01	8.42±0.1	12.57±0.5	19.7±0.001	25.1±0.01	31.7±0.001	33.2±0.6	36.3±0.1	38.3±0.1	40.4±0.3
Plot II	2.2±0.01	11.5±0.6	12.3±0.9	14.32±0.9	21.85±0.01	24.03±0.5	33.08±0.002	39.5±0.001	45.52±0.32	51.22±0.1
Plot III	3.6±0.01	14.5±0.01	19.4±0.001	24.2±0.3	34.2±0.8	36.7±0.002	44.89±0.1	50.21±0.1	60.92±0.001	66.54±0.03

± SEM
Plot I –control ; Plot II-Chemical fertilizer applied ; Plot III – vermicompost applied

Table 5: Average number of branches (mean of 15 values) in plants

Category	3 DAG	6DAG	9DAG	12DAG	15DAG	18DAG	21DAG	24DAG	27DAG	30DAG
Plot I	-	-	-	-	-	3.126±0.03	4.1±0.1	4.18±0.009	4.43±0.03	5.00±0.01
Plot II	-	-	-	-	2.066±0.01	4.1±0.002	4.3±0.003	4.4±0.6	4.8±1.2	5.5±0.1
Plot III	-	-	2.06±0.1	3.12±0.01	4.1±0.007	5.00±0.02	6.00±0.01	6.02±0.02	7.10±0.001	8.01±0.001

± SEM
Plot I –control ; Plot II-Chemical fertilizer applied ; Plot III – vermicompost applied

Table 6: Average number of leaves (mean of 15 values) in plants

Category	3 DAG	6DAG	9DAG	12DAG	15DAG	18DAG	21DAG	24DAG	27DAG	30DAG
Plot I	2.1±0.03	5.3±0.01	8.0±0.07	12.1±0.2	13.3±0.001	14.2±0.2	16.2±0.12	21.06±0.001	30.009±0.001	32.8±0.2
Plot II	2.3±0.1	5.1±0.2	8.5±0.08	12.8±0.62	15.8±0.09	16.9±0.2	26.3±0.81	28.13±0.1	30.0±0.8	33.2±0.2
Plot III	3.4±0.08	6.0±0.001	13.1±0.2	15.8±0.8	19.3±0.12	21.3±0.4	28.9±0.001	31.3±0.1	36.2±0.01	38.9±0.001

± SEM
Plot I –control ; Plot II-Chemical fertilizer applied ; Plot III – vermicompost applied

Table 7: Average leaf length (in cms - mean of 15 values) of plants

Category	3 DAG	6DAG	9DAG	12DAG	15DAG	18DAG	21DAG	24DAG	27DAG	30DAG
Plot I	2.25±0.07	2.39±0.1	4.2±0.001	4.8±0.1	4.5±0.8	4.7±0.001	5.1±0.12	6.00±0.10	6.5±0.38	7.0±0.8
Plot II	2.98±0.0001	3.01±0.2	3.2±0.8	4.91±0.01	5.20±0.32	5.92±0.1	6.01±0.3	6.92±0.001	7.1±0.3	7.32±0.005
Plot III	3.0±0.005	3.92±0.001	4.23±0.03	5.03±0.56	5.93±0.21	6.31±0.001	6.93±0.1	7.01±0.002	8.0±0.001	8.31±0.0012

± SEM
Plot I –control ; Plot II-Chemical fertilizer applied ; Plot III – vermicompost applied

Table 8: Average number of flowers (mean of 15 values) in plants

Category	3 DAG	6DAG	9DAG	12DAG	15DAG	18DAG	21DAG	24DAG	27DAG	30DAG
Plot I	-	-	-	-	4.3±0.062	5.98±0.03	7.000±0.001	7.801±0.8	7.801±0.008	8.923±0.001
Plot II	-	-	4.83±0.002	5.83±0.32	6.823±0.01	7.823±0.003	8.130±0.111	8.238±0.12	8.339±0.111	9.981±0.10
Plot III	-	-	-	4.12±1.11	5.08±0.81	7.038±0.001	8.001±0.121	8.110±0.008	8.221±0.004	9.089±0.001

± SEM
Plot I –control ; Plot II-Chemical fertilizer applied ; Plot III – vermicompost applied

Table 9 : Average number of seeds on 31st DAG (mean of 15 values)

Plot I	Plot II	Plot III
154 ± 1.184	282.6 ± 0.003	398.7 ± 0.001

± SEM

Table 10 : Average root length (cms) of plants on 32st DAG (mean of 15 values)

Plot I	Plot II	Plot III
11.321 ± 0.01	13.55±0.2	15.41±0.001

± SEM

vermicompost over chemical fertilizer and control. On the whole on 30 DAG, vermicompost produced best results with respect to plant height, shoot length, number of branches / plant, number of leaves / plant, leaf length, number of seeds / plant and root length. However, chemical fertilizer slightly took over vermicompost in number of flowers /plant (Table 8).

As evident from Table 11, net production of 4 kg of *Amaranthus* / plot was obtained with vermicompost, while only 2.5 kg/plot (8.25 sq.ft / 32 days) with chemical fertilizer. While, good survival rate (96%) was observed with excess application of vermicompost on *Amaranthus plant*, low % survival (16%) was seen with excess application of chemical fertilizer (Table 12), clearly pointing out the advantages of going in for the use of vermicompost in plant cultivation.

The present study has also proven the fact that vermicompost has positive influence on the *Amaranthus* plant, in terms of its biochemical parameters like Total chlorophyll (Table 13) ; Chlorophyll A (Table 14) ; Clorophyll B (Table 15); Carotenoid content (Table 16) ; Total sugar content (Table 17) ; reducing sugar (Table 18) and non-reducing sugar (Table 19) in plant tissues, over chemical fertilizer and control. Similar is the case for vermicompost,with % nitrogen content (Table 20) ; phosphorous content (Table 21) and potassium content (Table 22) of plant tissues, over chemical fertilizer and control.

Likewise, vermicompost has positive influence on the soil as well, in terms of % of organic matter per gram of soil (Table 23) and percentage of available nitrogen in soil (Kg/ha)(Table 24), when applied for plant cultivation, over chemical fertilizer and control.

In the present study, 2.5 fold reduction in the total quantum of organic waste (130Kg) used could be achieved with vermicomposting, similar to 2.46 fold reduction in quantum of neem leaf (240Kg) and eucalyptus leaf litter (130 Kg)[2] through vermicompost, 2.52 fold with poultry waste (630 Kg)[12] and 2.57 fold with organic waste (265 g) [13]

In the present study, composition of vermicompost has been analysed to be 120.5 ppm for nitrogen, 18.39 ppm for phosphorous and 50.99 ppm for potassium. Higher NPK values for vermicompost had beeen reported[14] These parameters depends on the characteristics of each process[15].

Beneficial impact of vermicompost on the growth of *Amaranthus* plant had been clearly demonstrated in the present study. Similar reports had been made in beans[16],ornamental plants[17] and brinjal[18]. This may be due to the presence of increased amount of available nitrogen and organic matter content in vermicompost[19]. Further, it may also possibly be due to the presence of plant growth hormones like auxin, giberlins and cytokinins in vermicompost[13]

In total, in the present field trial, the net production rate of *Amaranthus* plant had been considerably improved (4 kgs / 8.25 sq.ft/32 days) through vermicompost application over chemical fertilizer (2.5Kgs /8.25 sq.ft /32 days).Similarly in okra plant, while 270gm has been harvested with vermicompost, only 63 gm with chemical fertilizer and in sugarcane too the higher rate obtained with vermicompost (141.38tonnes) than with chemical fertilizer (121.36 tonnes)[20].

In the present study, vermicompost applied *Amaranthus* plant had higher content of chlorophyll A, B and total chlorophyll than chemical fertilizer applied plants and control plants. Increased amount of total chlorophyll for ornamental plants[17].

Carotenoids function as accessory pigments in photosynthesis and as coloring matter in leaves, flowers. In the present study, increased carotenoid content has been recorded for plants grown with vermicompost than chemical fertilizer and control. This is in line with the earlier reports on ornamental plants[17].

In the present study, reducing sugar content of Amaranthus plant was lower with vermicompost than with chemical fertilizer and the content was vice versa for non-reducing sugar and total sugar. An increased total carbohydrate content in okra grown with vermicompost over chemical fertilizer and control plants[20].

Present study clearly demonstrated that vermicompost has positive influence on plant tissues in terms of nitrogen content over chemical fertilizer and control like in the study involving ragi plant by using vermicompost[20].Similarly, phosphorous and potassium content of *Amaranthus* plant also had been increased with vermicompost.

Soil analysis revealed that vermicompost applied soil had higher organic matter and available nitrogen than chemical fertilizer applied soil. Application of vermicompost to soils increased their microbial biomass and dehydrogenase activity. Humic materials and other

Table 11 : Net production of Amaranthus species

Using vermicompost (Kg)	Using chemical fertilizer (kg)
4 / plot	2.5/plot

Plot area – 8.25 Sqft / 32 days

Table 12 : Number of survivors(*Amaranthus* sp. plants) after exposure to excess vermicompost / chemical fertilizer

Category	Number of survivors				
	0 DAE	8DAE	15DAE	18ADE	% of survival
Plot IV	50	48	48	48	96
Plot V	50	30	23	8	16

DAE – days after exposure

Plot IV – 350 g of vermicompost applied plot

Plot V - 350 g of chemical fertilizer applied plot

Table 13 : Average total chlorophyll (mg/gms) present (mean of 4 values) in plants

Category	9DAG	12DAG	15DAG	18DAG	21DAG	24DAG	27DAG
Plot I	1.641 ±0.01	2.078 ±0.1	2.611 ±0.02	2.387 ±0.1	2.113 ±0.8	1.473 ±0.01	1.526 ±0.6
Plot I	1.599 ±0.8	1.886 ±0.31	2.884 ±0.003	3.08 ±0.03	1.849 ±0.01	2.143 ±0.032	2.836 ±0.08
Plot III	1.899 ±0.023	3.133 ±0.06	3.427 ±0.009	3.46 ±0.001	2.737 ±0.011	2.688 ±0.12	3.5 ±0.3

± SEM

Plot I –control ; Plot II-Chemical fertilizer applied ; Plot III – vermicompost applied

Table14 : Average chlorophyll - A (mg/gms) present (mean of 4 values) in plants

Category	9DAG	12DAG	15DAG	18DAG	21DAG	24DAG	27DAG
Plot I	1.328±0.03	1.721±0.006	2.455±0.6	2.1±0.001	1.856±0.5	1.216±0.001	1.284±0.01
Plot II	1.284±0.31	1.603±0.1	2.445±0.121	1.721±0.001	1.459±0.521	1.753±0.003	1.396±0.002
Plot III	1.398±0.122	1.767±0.12	2.037±0.001	1.964±0.01	2.175±0.001	2.126±0.13	1.964±0.0032

± SEM

Plot I –control ; Plot II-Chemical fertilizer applied ; Plot III – vermicompost applied

Table15 : Average chlorophyll - B (mg/gms) present (mean of 4 values) in plants

Category	9DAG	12DAG	15DAG	18DAG	21DAG	24DAG	27DAG
Plot I	0.313±0.3	0.357±0.1	0.156±0.1	0.416±0.001	0.257±0.01	0.257±0.31	0.242±0.03
Plot II	0.315±0.31	0.283±0.002	0.439±0.003	0.359±0.32	0.393±0.001	0.390±0.02	1.440±0.001
Plot III	0.501±0.18	1.366±0.001	0.490±0.002	0.496±0.008	0.526±0.002	0.562±0.2	1.536±0.1

± SEM

Plot I –control ; Plot II-Chemical fertilizer applied ; Plot III – vermicompost applied

Table16 : Average carotenoid content (mg/gms) (mean of 4 values) in plant tissue

Category	9DAG	12DAG	15DAG	18DAG	21DAG	24DAG	27DAG
Plot I	0.537±0.01	0.957±0.1	1.135±0.1	1.346±0.3	0.808±0.0001	0.595±0.003	0.590±0.01
Plot II	0.548±0.02	0.775±0.09	0.899±0.03	1.136±0.001	0.866±0.1	0.907±0.21	0.740±0.1
Plot III	0.609±0.01	0.966±0.3	1.394±0.01	1.48±0.001	0.942±0.001	0.990±0.003	1.000±0.113

± SEM

Plot I –control ; Plot II-Chemical fertilizer applied ; Plot III – vermicompost applied

Table17 : Average total sugar content (mg/gms) (mean of 4 values) in plant tissue

Category	9DAG	12DAG	15DAG	18DAG	21DAG	24DAG	27DAG
Plot I	55.67±0.01	76.13±0.13	100.25±1.12	75.38±0.03	88.35±1.110	124.13±1.31	125.13±1.32
Plot II	105.46±1.32	89.80±0.001	72.35±1.110	88.56±0.332	111.63±0.31	134.6±1.32	144.63±1.135
Plot III	124.89±0.001	102.56±0.08	142.35±1.132	153.58±1.32	163.44±0.001	171.13±0.006	180.13±3.11

± SEM

Plot I –control ; Plot II-Chemical fertilizer applied ; Plot III – vermicompost applied

Table18: Average reducing sugar content (mg/gms) (mean of 4 values) in plant tissue

Category	9DAG	12DAG	15DAG	18DAG	21DAG	24DAG	27DAG
Plot I	8.271±0.01	9.346±0.06	10.255±0.123	7.666±0.1	7.857±0.001	11.197±0.001	7.190±0.121
Plot II	9.015±0.31	9.677±0.001	9.594±1.003	8.022±0.32	10.173±0.01	13.316±0.1	14.00±0.003
Plot III	7.195±0.06	11.166±0.002	13.316±0.001	7.857±0.12	7.526±1.32	7.357±1.21	15.677±0.132

± SEM
Plot I –control ; Plot II-Chemical fertilizer applied ; Plot III – vermicompost applied

Table 19 : Average non- reducing sugar content (mg/gms) (mean of 4 values) in plant tissue

Category	9DAG	12DAG	15DAG	18DAG	21DAG	24DAG	27DAG
Plot I	47.399±0.031	66.784±1.32	89.995±1.110	67.714±0.331	75.413±0.001	11.197±0.001	7.190±0.12
Plot II	96.445±1.324	80.123±0.001	62.756±0.001	80.538±1.324	101.457±0.032	13.316±0.1	14.000±0.003
Plot III	117.695±1.342	91.394±1.112	129.034±0.001	145.723±1.032	155.914±2.13	7.357±1.21	15.677±0.132

± SEM
Plot I –control ; Plot II-Chemical fertilizer applied ; Plot III – vermicompost applied

Table 20 : Percentage of nitrogen content in plant tissues (Mean of 4 values)

Plot I	Plot II	Plot III
1.458±0.008	1.656±0.001	1.996±0.03

± SEM
Plot I –control ; Plot II-Chemical fertilizer applied ; Plot III – vermicompost applied

Table 21: Percentage of phosphorous content (ppm) in plant tissues (Mean of 4 values)

Plot I	Plot II	Plot III
0.4 ± 0.1	0.65±0.2	1.21±0.1

± SEM
Plot I –control ; Plot II-Chemical fertilizer applied ; Plot III – vermicompost applied

Table 22: Percentage of potassium content (ppm) in plant tissues (Mean of 4 values)

Plot I	Plot II	Plot III
2.75±0.01	4.15±0.03	5.15±0.002

± SEM
Plot I –control ; Plot II-Chemical fertilizer applied ; Plot III – vermicompost applied

Table 23 : Percentage of organic matter per gm soil (Mean of 4 values)

Plot I	Plot II	Plot III
0.435±0.001	0.541±0.008	0.655±0.005

± SEM
Plot I –control ; Plot II-Chemical fertilizer applied ; Plot III – vermicompost applied

Table 24 : Percentage of available nitrogen in soil (Kg/ha) (Mean of 4 values)

Plot I	Plot II	Plot III
283.06±1.110	543.435±0.0081	629.4±1.001

± SEM
Plot I –control ; Plot II-Chemical fertilizer applied ; Plot III – vermicompost applied

plant growth-influencing substances, such as plant growth hormones, produced by microorganisms during vermicomposting, and produced after increased microbial biomass and activity in soils, may have been responsible for the increased growth and yields, independent of nutrient availability[21].Use of vermicompost can improve the quality of the plants and soil and save the soil from all the ill effects of pollution. Further, studies[22] indicate that integrated nutrition comprising vermicompost, fertilizers N and biofertilizers could be applied to achieve higher yields and sustain soil health.

Conclusion: Vermicompost application can improve net production and thus net gain; save cultivable lands from chemical fertilizers and pollution; make a good business thus can solve the problem of unemployment.

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