

## Studies on the Influence of Vermicompost and Vermiwash on the Growth and Productivity of Black Gram (*Vignamungo*)

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**Abstract:** Present investigation was carried out during 2010-2011 at Arakkonam, Vellore dt., Tamil Nadu, India, to study the effect of vermicompost and vermiwash on the growth and productivity of Black gram (*Vignamungo*). The soil quality was monitored during the experiment followed by growth and productivity. In a vermicompost 50% there has been a significant improvement in soil qualities in plots treated with vermiwash 15% and vermiwash 10%. The growth and yield of black gram was significantly higher in pots treated with vermicompost 50%.

**Key words:** Earthworm • Soil Fertility • Plant Productivity

### INTRODUCTION

A resolution is unfolding in vermiculture studies for vermicomposting of diverse organic wastes by vermiculture technology using waste eater earthworms in to a nutritive 'organic fertilizer' and using them for production 'of safe food', both in quantity and quality without recourse to agro-chemicals. Heavy use of agro-chemicals since the 'green revolution' of the 1960's boosted food productivity with the cost of environment and society. Chemically grown foods have adversely affected human health. The scientific community all over the world is desperately looking for an 'economically viable' socially, safe and environmentally sustainable alternative to the agro-Chemicals.

Vermiculture biotechnology promises to user in the 'second green revolution' by completely replacing the destructive agro-chemicals which did more harm than good to both the farmers and their farmlands during the 'first green revolution' of the 1950-60's. Earthworms restore and improve soil fertility and boost crop productivity by the use of their excreta-'vermicast'. They excrete beneficial soil microbes and secrete polysaccharides, proteins and other nitrogenous compound in to the soil. The promote soil fragmentation and aeration and bring about 'soil turning' and dispersion

in farm lands. Worm activity can increase air-soil volume from 8% to 30%. One acre of land can contain up to 3 million earthworms, the activities of which can bring up to 8-10 tons of 'top soil' to the surface every year. Presence of worms improves water penetration in compacted soils by 50% [1-3]. A study in India showed that an earthworm population of 0.2-1.0 million per hectare of farmlands can be established within a short period of three months. On an average 12 tons/hectare/year of soil or organic matters is ingested by earthworms, leading to up turning of 18 tons of soil/year and the world over at this rate it may mean a 2 inches of fertile humus layer over the globe [4, 5].

Earthworms have over 600 million years of experience in waste and land management, soil improvement and farm production. No wonder, Charles Darwin called them as the 'unheralded soldiers of mankind and farmer's friend working day and night under the soil' [6]. Importance of earthworms in growth of pomegranate fruit plants was indicated by the ancient Indian scientist surpala in the 10<sup>th</sup> century A.D. in his epic 'vrikshayurveda' (science of tree growing) [7].

Vermicompost has been emerging as an important source in supplementing chemical fertilizer in agriculture in view of sustainable development after Rio Conference, vermicompost is a bio fertilizer enriched with

all beneficial soil microbes and also contains all the essential plant nutrients like N, P and K. Vermicompost that is prepared through conventional method has standard values of total nitrogen: 94%, Phosphorous: 0.47% and potassium: 0.70% it is also enriched with various micronutrients such as Mg (0.46%), Fe (7563 ppm), Zn (278 ppm), Mn (475 ppm), Bo (34ppm), Cu (27ppm) (Gupta, 2003). Thus eliminate usage of any further artificial chemical inputs. Further, nutrients in vermicompost are often much higher than traditional garden compost [8]. It is non toxic utilize low energy input for composting and recycled bioorganic product. Due to absence of toxic enzymes it is also eco-friendly and has beneficial effect on the biochemical activities of the soil [9]. It also increases the quality, fertility and mineral content of the soil structure. It enhances soil aeration, texture and silt thereby reducing soil compaction. It also buildup water retention capacity of soil because of its high organic matter content and promotes better root growth and nutrient absorption [10].

Vermiwash, a foliar spray, is a liquid fertilizer collected after the passage of water through a column of worm activation. It is a collection of excretory products of earthworms, along with major micronutrients of the soil and soil organic molecules that are useful for plants. These bio-liquid is rich in nutrients and plant growth hormones. Vermiwash seems to possess an inherent property of acting not only as a fertilizer but also as a mild biocide.

This vermiwash would have enzymes, secretion of earthworms which would stimulate the growth and yield of crops and even develop resistance in crops receiving this spray, such preparation would certainly have the soluble plant nutrients apart from some organic acids and mucus of earthworm and microbes [11].

Among the insect pests, defoliators and pod borers during vegetative and post flowering stage are economically important causing considerable yield loss [12]; Extensive usage of inorganic fertilizers and 'pesticides' in agriculture has led to environment problems such as pesticide residues in food commodities bioaccumulation & biomagnifications of pesticides in food chains and loss of soil health. Owing to wide spectral problems with the use of chemical insecticides, organic farming is gaining popularity among the scientists and farming community. Vermicompost and vermiwash (a liquid manure), have been integral part of non-chemical based farming system such as organic farming, sustainable farming or eco-friendly farming. They in

several ways account for crop nourishment, pests resistance processes and soil fertility enhancement [13-17]. The present work was carried out to study both the combined and individual effect of vermicompost and vermiwash (i) on growth parameter's of the growth and productivity of Black gram (*Vigna mungo*).

## MATERIALS AND METHODS

The present investigation was carried out during the year 2010-2011 at Arakkonam, Vellore Dt., Tamil Nadu, India. We were recycling the wastes of our local farmland. For Preparation of vermicompost, the locally available earthworm species *Eisenia fetida*, *Perionyx excavatus*. Vermicompost can be prepared in pit with all convenient dimensions. The most convenient pit for easy handling should be two meter long, one meter wide and one meter deep. A five cm layer of broken bricks or sand should form the base of the pit and restrict the movement of earthworm into the soil. Above this 15 cm of loamy soil or garden soil should be spread and on this small lumps of fresh cattle dung should be sprinkled at random. This forms the active growing medium for earthworms and is called vermibed. About 100-500 earthworms should be put in the vermibed which should be kept sufficiently constantly moist. A layer of 10 cm thick of straw, leaf litter and variety of farm residue should be placed over this. Cow dung slurry should be sprinkled. The above set of layers repeated up to a height of 1m; after finishing this pit with residues water should be kept constantly moist. After 45<sup>th</sup> day the heap will be ready for harvest with brown vermicomposting. The worms can be separated easily from the worm cast by dumping the whole material and forming a small cone shaped heap and left for three to four hours. The worms aggregate at the mound. The mound is served through 3 mm sieve to separate the cocoon and young earthworm. The pit should be free from white ants, red ants, centipedes, rats and poultry birds. Use *Lantana camara* leaves to control ants. Don't use any insecticide. Finally, few organic wastes could be converted into eco-friendly, non-hazardous, unpolluted, non-toxic, nutrient rich organic manure. The vermicompost contains 5, 7, 11, 2 and 2 times nitrogen, phosphorous, potassium, calcium and magnesium than crop waste or animal manure which is easily available to the crops, Matured vermicompost is applied at the rate (Urban horticulture development centre, Tamil Nadu agricultural University).

Table 1: Showing the various concentration of vermicompost and vermiwash

S. No	Treatment	Biofertilizer Used	Concentration
1.	Control	----	100ml Deionised Water
2.	Vermicompost (50%)	Vermicompost	50% VC + Soil
3.	Vermiwash (100 $\mu$ m)	Vermiwash I	10+90ml
4.	Vermiwash (150 $\mu$ m)	Vermiwash II	15+85ml

Vermiwash unit was setup by the method suggested by Ismail [16]. An empty 50 liter capacity plastic container was taken and a tap was fitted on the side. The entire unit was setup on a short pedestal made of few bricks to facilitate easy collection of vermiwash. The tap is kept open and a base layer of coarse sand up to 10cm was placed in the plastic bucket. Water was made to flow through these layers so as to set up a basic filtering unit. On this layer 10cm layer of loamy soil was placed and moistened. In to this 15 number of epigeic and anecic earthworm were introduced, cattle dung pots and hay was placed on top of the soil layer and moistened. The tap was kept open for the next 15 days and water was added every day to keep the unit moist. On the 16<sup>th</sup> day the tap was closed and a perforated plastic container was suspended. One liter of water was taken in the container and was allowed to gradually sprinkle on to the bucket over night. Vermiwash was collected the next morning and the suspended container was refilled with water to be collected again the following morning. Pot experiments with *V. mungo* were carried out applying different concentration of vermicompost and vermiwash as foliar sprays with deionised water as control to study the difference in the exo-morphological characters that may develops in response to their applications. To the foliar spray solution 0.01% of teepol was added to act as a surfactant which enhances adherence of the spray solution to the leaves. The spraying was done using an atomizer until there was run-off of the excess spray solutions. The various concentrations of vermicompost and vermiwash that was used as foliar sprays for *V. mungo* are given in Table 1.

Seedling of *Vignamungo* were raised in wide posts of 60cm diameter and transplanted to pots of uniform size of 30cm diameter. The pots were filled with sand, red soil and farm yard manure in the ration of 1:1:1. The plants were maintained under garden land conditions. The plants were grown in each pot and three pots were maintained for each treatment including controls. Plants were irrigated with well water uniformly throughout the period of experiment. Experiments were started when the plants were 10 days old since it has a life cycle of 40-45 days only. The spraying was done at the end of each week to continue at the yield. The following exo morphological characters were carried out in control and treated plants.

**Exo-Morphological Studies:** At the end of every week of spray and at zero hour i.e. just before giving the spray application the following exo-morphological data were recorded in the control and treated plants. Experiments were repeated thrice in order to make sure that uniform results and analyzed in each of the studies under taken. 1. Height of the plants, 2. Length of Inter node, 3. Number of leaves and 4. Number of branches.

**Measurements of Plant Growth Parameters:** Plant height and length of inter node (cm) was recorded using a measuring tape. Count the number of leaves and number of branches. Leaf surface was measured by using of graph paper.

**Statistical Analyses:** Data on morphological parameters was subjected to statistical analyses. All data were expressed as mean and standard error. The differences between groups were statistically analyzed by analysis of variance (ANOVA). The level of significance was set at  $P < 0.05$ .

## RESULTS

The following exo-morphological character was observed at the interval of every seven days in control and treated samples throughout the experimental period.

**Plant Height:** All treatments showed significant value for plant height when compared to control with maximum shoot length observed in vermin compost 50%. Plant height at zero hour i.e at the time of starting experiment is 8.5cm. After the first apply and spray, the height of all the treated plants showed a significant increase over that of control similar effect is observed at the end of the second, third and fifth week sprays (Table 2). The plant height consistently increased to a maximum in plants treated with vermicompost 50% and 15.2cm in plants treated with Vermiwash-II (14.33cm), this is followed by plants treated with Vermiwash-I (14.22cm). The mean height is 12.22cm in the control plants (Fig. 1).

**Length of Inter Node:** The mean length of inter node at zero hour is 0.1cm. After the first apply and spray the length of inter node shows a significant increase over that of control in all the treated plants. The increase in inter node length is maximum (2.1cm) at the end of fifth week of spray in plants treated with vermicompost 50% followed by the plants treated with Vermiwash-I (1.58cm) and Vermiwash-II (1.67cm). Inter node length is minimum in the control plants (1.50cm) (Table 3 & Fig. 2).

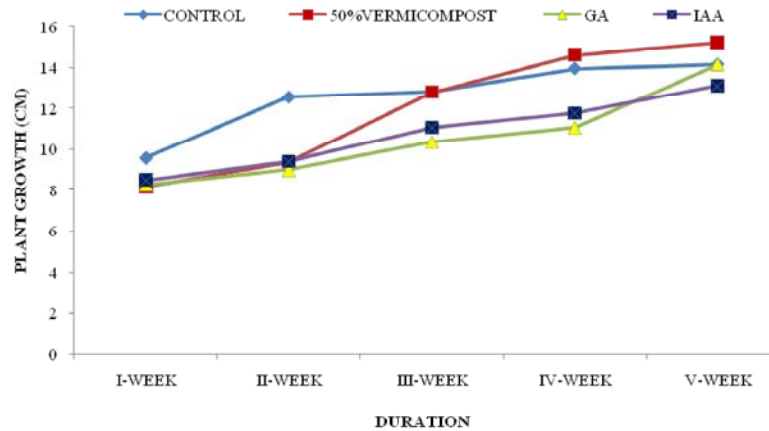


Fig. 1: Shoot Length of *Vignamungo* treated with Vermicompost and PGRs

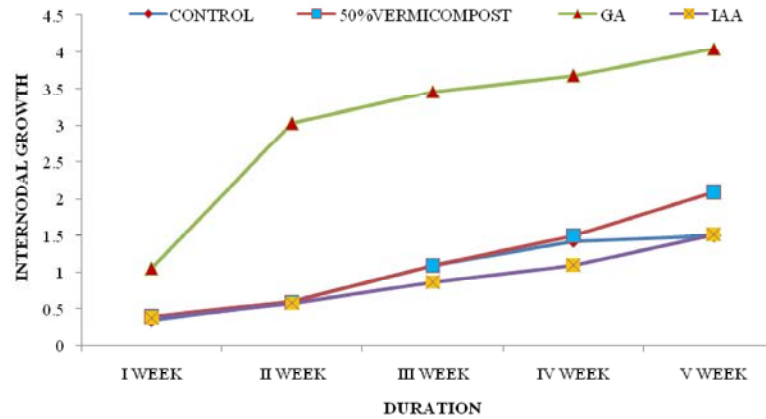


Fig. 2: Internodal Length of *Vignamungo* treated with Vermicompost and PGRs

Table 2: Effect of Vermicompost and PGRs on the Shoot Length (cms) of *Vignamungo*

TREATMENT	I – WEEK	II – WEEK	III – WEEK	IV - WEEK	V – WEEK
CONTROL	9.58 <sup>ab</sup> ±0.14 (+57.5)	12.56 <sup>ab</sup> ±0.80 (+75.4)	12.83 <sup>ab</sup> ±0.19 (+77.0)	13.95 <sup>ab</sup> ±0.42 (+83.7)	12.22 <sup>ab</sup> ±0.56 (+73.3)
VERMICOMPOST-50%	8.16 <sup>ab</sup> ±0.22 (+49.0)	9.33 <sup>ab</sup> ±0.20 (+56.0)	12.8 <sup>ab</sup> ±0.30 (+76.8)	14.6 <sup>ab</sup> ±0.31 (+87.6)	15.2 <sup>ab</sup> ±0.32 (+91.3)
GA	8.25 <sup>ab</sup> ±0.38 (+49.5)	8.98 <sup>ab</sup> ±0.31 (+53.5)	10.35 <sup>ab</sup> ±0.24 (+61.9)	11.06 <sup>ab</sup> ±0.24 (+66.4)	14.15 <sup>ab</sup> ±0.43 (+84.9)
IAA	8.5 <sup>ab</sup> ±0.31 (+51.00)	9.4 <sup>ab</sup> ±0.33 (+56.4)	11.08 <sup>ab</sup> ±0.49 (+66.48)	11.78 <sup>ab</sup> ±0.56 (+70.7)	13.12 <sup>ab</sup> ±0.20 (+78.7)

Table 3: Effect of Vermicompost and PGRs on Internodal Length (cms) of *Vignamungo*

TREATMENT	I-WEEK	II – WEEK	III – WEEK	IV - WEEK	V – WEEK
CONTROL	0.35 <sup>ab</sup> ±0.04 (+2.10)	0.60 <sup>ab</sup> ±0.09 (+3.6)	1.10 <sup>ab</sup> ±0.09 (+6.6)	1.43 <sup>ab</sup> ±0.11 (+8.6)	1.5 <sup>ab</sup> ±0.07 (+9.0)
VERMICOMPOST-50%	0.4 <sup>ab</sup> ±0.04 (+2.40)	0.6 <sup>ab</sup> ±0.04 (+3.6)	1.1 <sup>ab</sup> ±0.09 (+6.6)	1.5 <sup>ab</sup> ±0.12 (+9.0)	2.1 <sup>ab</sup> ±0.23 (+14.3)
GA	1.06 <sup>ab</sup> ±0.30 (+6.36)	3.03 <sup>ab</sup> ±0.35 (+18.18)	3.46 <sup>ab</sup> ±0.30 (+20.76)	3.68 <sup>ab</sup> ±0.33 (+22.1)	4.04 <sup>ab</sup> ±0.30 (+24.3)
IAA	0.38 <sup>ab</sup> ±0.06 (+2.3)	0.58 <sup>ab</sup> ±0.07 (+3.5)	0.87 <sup>ab</sup> ±0.07 (+5.2)	1.1 <sup>ab</sup> ±0.07 (+6.6)	1.52 <sup>ab</sup> ±0.08 (+9.8)

Table 4: Effect of Vermicompost and PGRs on the Number of Leaves (n) of *Vignamungo*

TREATMENT	I-WEEK	II – WEEK	III – WEEK	IV - WEEK	V – WEEK
CONTROL	5.30 <sup>ab</sup> ±0.19 (+32.00)	6.80 <sup>ab</sup> ±0.55 (+41.00)	8.80 <sup>ab</sup> ±0.49 (+53.00)	9.80 <sup>ab</sup> ±0.37 (+59.00)	10.2 <sup>ab</sup> ±0.49 (+61.80)
VERMICOMPOST-50%	6.16 <sup>ab</sup> ±0.55 (+37.0)	9.0 <sup>ab</sup> ±0.50 (+54.0)	13.0 <sup>ab</sup> ±0.61 (+78.0)	17.83 <sup>ab</sup> ±0.62 (+107.0)	22.5 <sup>ab</sup> ±0.70 (+135.0)
GA	5.50 <sup>ab</sup> ±0.46 (+33.0)	8.0 <sup>ab</sup> ±0.24 (+48.0)	10.30 <sup>ab</sup> ±0.45 (+61.8)	13.67 <sup>ab</sup> ±0.56 (+82.0)	16.17 <sup>ab</sup> ±0.55 (+97.0)
IAA	5.30 <sup>ab</sup> ±0.19 (+32.0)	5.83 <sup>ab</sup> ±0.64 (+35.0)	7.83 <sup>ab</sup> ±0.15 (+47.0)	9.83 <sup>ab</sup> ±0.37 (+59.0)	11.5 <sup>ab</sup> ±0.39 (+69.0)

**Number of Leaves:** The mean number of leaves at zero hours is 2. After the apply, the number of leaves shows a significant increase over that of control in all the treated plants. Increase the number of leaves is maximum (22.5) at the end of fifth weeks of

spray in plants treated with vermicompost 50% followed by plants treated with Vermiwash-II (13.16) and Vermiwash-I(10.3). The number of leaves is minimum in the control plants (10.2). (Table. 4 & Fig. 3).

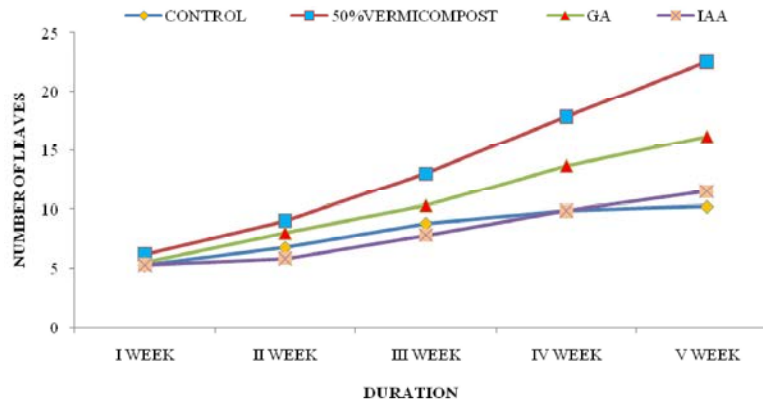


Fig. 3: Number of Leaves treated with Vermicompost and PGRs of *Vignamungo*

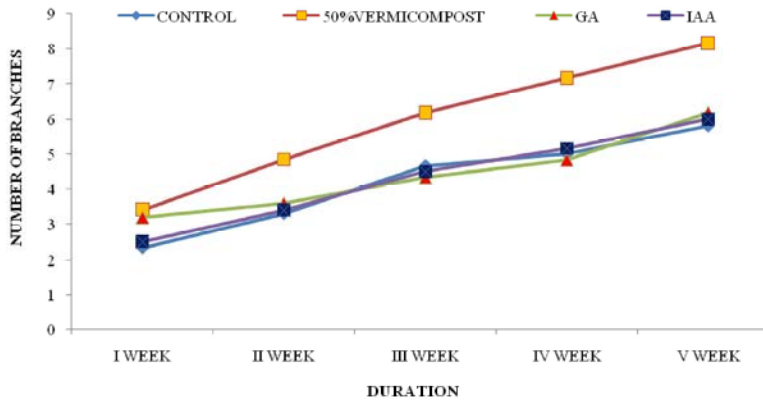


Fig. 4: Number of Branches treated with vermicompost and PGRs

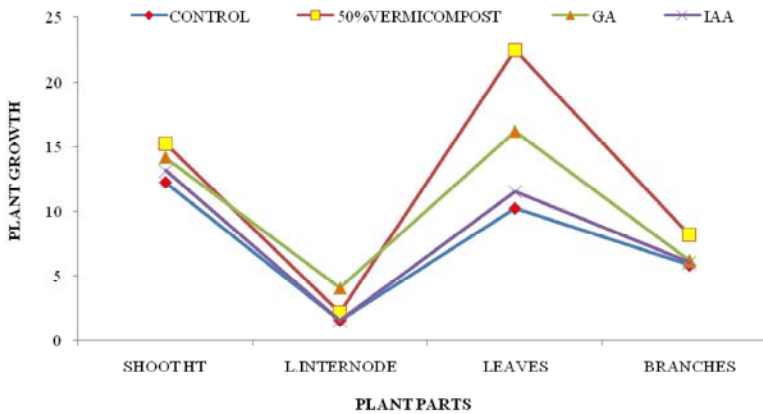


Fig. 5: Different exo-morphological characters at different treatments of *Vignamungo*.

**Number of Branches:** The mean value of number of branches at zero hour is (2.0). In the experimental period, the number of branches shows a significant variation over that of control in all the treated plants.

The maximum increase of number leaves is 8.16 at the end of fifth weeks of spray in plants treated with vermicompost 50% followed by plants treated

with Vermiwash-II (7.00) and Vermiwash-I(6.33). The number of branches is minimum in the control plants (5.80) (Table. 5 & Fig. 4). The comparative table shows a significant increase of all the exo-morphological characters in the experimental plants at the different intervals (Table. 6 & Fig. 5).

Table 5: Effect of Vermicompost and PGRs on the Number of Branches (n) of *Vignamungo*

TREATMENT	I-WEEK	II – WEEK	III – WEEK	IV - WEEK	V – WEEK
CONTROL	2.33 <sup>ab</sup> ±0.22 (+14.0)	3.30 <sup>ab</sup> ±0.19 (+20.0)	4.66 <sup>ab</sup> ±0.30 (+28.0)	5.03 <sup>ab</sup> ±0.28 (+32.0)	5.83 <sup>ab</sup> ±0.44 (+35.0)
VERMICOMPOST-50%	3.40 <sup>ab</sup> ±0.20 (+21.0)	4.83 <sup>ab</sup> ±0.28 (+29.0)	6.17 <sup>ab</sup> ±0.28 (+37.0)	7.16 <sup>ab</sup> ±0.57 (+43.0)	8.16 <sup>ab</sup> ±0.24 (+49.0)
GA 3.20 <sup>ab</sup> ±0.11 (+19.0)	3.60 <sup>ab</sup> ±0.20 (+22.0)	4.33 <sup>ab</sup> ±0.22 (+26.0)	4.83 <sup>ab</sup> ±0.28 (+29.0)	6.17 <sup>ab</sup> ±0.28 (+37.0)	
IAA 2.50 <sup>ab</sup> ±0.13 (+15.0)	3.40 <sup>ab</sup> ±0.20 (+21.0)	4.50 <sup>ab</sup> ±0.30 (+27.0)	5.16 <sup>ab</sup> ±0.29 (+31.0)	6.00 <sup>ab</sup> ±0.33 (+36.0)	

## DISCUSSION

The growing concern for an ecologically sound agricultural system without pesticides has added new dimensions to the economics of bio dynamics. Reliance on organic matter sources is a central feature of organic agriculture. It involves the harnessing of soil organisms like bacteria, earthworms and other micro fauna in recycling organic wastes like straw, grass, leaves twigs, weeds etc. and their transformation to produce slow release nutrients as needed by the crop [18].

The use of foliar fertilizer in agriculture has been a popular practice with farmers since the 1950s. Growth and development events in plants are controlled by growth regulators [19]. These are found naturally in plants or manufactured. PGRs, a new generation of agrochemicals used as foliar fertilizer, modifies the natural growth right from seed germination to senescence in crop plants. But the production of these agrochemicals is not economically feasible and the optimum conditions at which they can perform is difficult to ascertain. Moreover due to health and environmental pollution problems, the need for an organic liquid fertilizer arises [20, 21]. Though several organic fertilizers in the form of farm yard manure, green leaf manure, bio fertilizer and bio waste have been applied, the need for liquid fertilizers has evinced interest in the production of several such materials to serve as foliar sprays [22]. Vermiwash is an organic liquid fertilizer used in agriculture, is collected after the passage of water through a column of worm activation. It is a collection of excretory and secretory product of earthworm, along with major micronutrients of the soil and soil organic molecules that are useful for plants [23] and also acts as a mild biocide [24].

However, very little information is available that demonstrates the potential of the organic liquid fertilizer and their role in providing a balanced nutrient supply. The present work is taken up in *Vignamungo* in order to evaluate the growth promoting effects of vermicompost and vermiwash.

The physiochemical properties of vermiwash and vermicompost listed in agreement with the work done by Ismail [16]. The carbon: Nitrogen ratio was reduced to 8.80 by process of vermicomposting, which is indicative of

completion of composting process. The micronutrients are available in significant quantity. The liquid extract obtained through earthworm worked soil is referred to as vermiwash indicated the presence of micronutrients in significant quantity [23, 25]. The maximum increase of available nitrogen in chemical fertilizers can be accounted for because of the highest percentage of available nitrate it contained. Using vermiwash and vermicompost may attribute the significant increase in nitrogen of the soil by using vermiwash and vermicompost due to the presence of nitrogen fixing bacteria, which increase the nitrogen content of the soil [26-28]. The maximum increase in magnesium was observed for vermiwash and vermicompost followed by vermiwash and cattle dung. The maximum increase in vermiwash and vermicompost is due to greater availability of  $Mg^{2+}$  in vermicompost and vermiwash [27, 28].

Bio-fertilizers (Vermiwash and vermicompost) contribute macronutrients and micronutrients in amount that is required by plants. According to [26], applications of organic fertilizers have an emphatic effect on plant growth and production. The soil enriched with vermicompost provides additional substances that are not found in chemical fertilizers [23, 29]. Data clearly indicate a better performance of Okra using the contribution of vermiwash and vermicompost. Results are in agreement with those obtained by earlier workers [25-29]. The effects of vermicomposts on plants are not solely attributed to the quality of mineral nutrition is provided but also to its other growth regulating components such as plant growth hormones and humic acids. Furthermore, the application of vermicomposts in the field enhances the quality of soils by increasing microbial activity and microbial biomass which are key components in nutrient cycling, production of plant growth regulators and protecting plants soil-borne disease and arthropod pest attacks.

## ACKNOWLEDGEMENTS

One of us (G.S. Rekha) is grateful to Dr. M.M. Karthikeyan, Assistant professor in P.G. Department of Zoology for encouragement, support and to the Principal, Pachaiyappas College for Men, Kanchipuram for granting the permission to conduct this study.

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