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# Effect of Vermicompost Prepared from Aquatic Weeds on Growth and Yield of Eggplant (*Solanum melongena* L.)

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**Abstract**

The aim of the present investigation was to study the effect of vermicompost prepared from two different aquatic weeds on eggplant (*Solanum melongena* L.) growth and yield under greenhouse conditions. The experiment was conducted at the botanical garden of Annamalai University during December, 2011 to June, 2012. Vermicompost was prepared from cow dung and aquatic weeds i.e., *Azolla* and *Eichhornia* by using earthworms (*Eudrilus eugeniae*). The pot experiment was conducted with four treatments via $T_1$–(Control), $T_2$ (Cow dung), $T_3$ (*Azolla*), and $T_4$ (*Eichhornia*). The experimental results showed significant variations in plant growth and yield on par with the physico-chemical properties of different vermicomposts. The growth characters of brinjal such as plant height, number of leaves per plant were observed at 20th day, 40th day and 80th day from the date of planting. There was maximum value of growth parameters observed in egg plant treated with *Azolla*-vermicompost followed by *Eichhornia*-vermicompost and cow dung-vermicompost. The yield parameters such as number of days for flowering, number of fruits per plant and fruit length and width also showed similar trend of growth parameters. The investigation clearly reveals that the biochemical properties of vermicompost play a major role in the growth and development of egg plant.

**Keywords:** Vermicompost; Earthworms; *Azolla*; *Eichhornia*; Cow dung; Eggplant; Aquatic weeds

## Introduction

Increasing population of the world has doubled the food demands and inundated the available land sources [1]. The need of increased food production in most developing countries becomes an ultimate goal, to meet the dramatic expansion of their population [2]. Among the major food crops, vegetables are the most important one by cultivation and consumption. The nutritional content of vegetables varies considerably as they contain a great variety of other phytochemicals and other antioxidant properties. Generally, vegetables are cultivated in all part of the world by using different inputs like chemical fertilizers and pesticides, organic fertilizers, biofertilizers and biopesticides, etc. In recent days, the use of different organic fertilizers, biofertilizers and biopesticides are being recommended not only to minimize the use of hazardous chemical inputs but also for sustainable crop production particularly in vegetables' cultivation.

Among the immature vegetables, brinjal not only occupies a major area in cultivation but also by consumption in Tamil Nadu. Egg plant, *Solanum melongena* L. also known as Aubergine in Europe, Brinjal in India, is one of the non-tuberous species of the night shade family *Solanaceae* [3]. The varieties of *Solanum melongena* L. show a wide range of fruit shapes and colours, ranging from white, yellow, green through degrees of purple pigmentation to almost black [4]. It is an economically important crop in Asia, Africa and the Subtropics (India and Central America) and it is also cultivated in some warm temperate regions of the Mediterranean and South America [5]. The fruits are known for being low in calories and having a mineral composition beneficial for human health. They are also rich source in Potassium, Magnesium, Calcium and Iron [6]. Unripe fruit of egg plant is primarily used as cooking vegetable [7]. Egg plant is perennial but grown commercially as an annual crop. Asia has the largest egg plant production which comprises more than 90% of the world production and 299,770 ha in area of cultivation. It has many medicinal values and its fruit helps to lower the blood cholesterol levels, and is suitable as a part of a diet to help regulate high blood pressure [8].

Fertilizers provide plants with the nutrients necessary for healthy growth. Apart from the macronutrients, there is a known suite of micronutrients that play important roles in the plants metabolism. Fertilizers can be applied as either organic or inorganic. Inorganic fertilizers, compost or manure prepared from vegetative matter or animal excreta has been utilized due to its high value of physical and chemical properties. But in modern agriculture, the chemical fertilizers and pesticides are being applied indiscriminately with desire of getting higher yield which deteriorate the soil fertility as well as crop quality. But in recent years, the chemical fertilizers have produced undesirable effects on the soil [9]. The foliar application of humic acid on vegetables particularly in brinjal increases growth and yield parameters when compared to chemical nitrogen fertilizers [10]. Using of organic fertilizers serves as a good and suitable source to supply soil food elements. Among the organic manure, vermicompost is one of the best organic manure in increasing the crop yield. It contains growth regulators like growth hormones which increase the growth and yield of crops [11]. Compost plays an important role for improving soil physical properties and contains higher levels of relatively available nutrient elements, which are essential for plant growth [12].

Vermicomposting involves the bio-oxidation and stabilization of organic material by the joint action of earthworms and microorganisms. Although it is the microorganism, that biochemically degrade the organic matter, earthworms are the crucial drivers of the process, as they aerate and fragment the substrate there by drastically altering the

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microbial activity and increasing the surface area thus making much more microbial activity and further decomposition [13]. Vermicompost is being a stable fine granular organic matter, when added to soil, it loosens the soil and improves the passage to the entry of air. The mucus associated with the cast being hydroscopic absorbs water and prevents water logging and improves water holding capacity. The organic carbon in vermicompost releases the nutrients slowly and steadily into the system and enables the plant to absorb nutrients. The soil enriched with vermicompost provides additional substances that are not found in chemical fertilizers [14]. Aquatic weed plants grow very luxuriously in lotic and lentic type of water bodies, they have a devastating effect on water quality. They can bring rivers and lakes to a standstill and destroy the livelihoods of communities that depend on them. Nowadays, the aquatic weeds are obnoxious to eradicate from natural environment which create pollution. So the present study was carried out to examine the effect of vermicompost prepared from different aquatic weeds such as *Azolla spp. and Eichorrnia spp*. on growth and yield of egg plant.

## Materials and Methods

Epigeic species, *Eudrilus eugeniae* was obtained from M/s Vishal vermifarm, Nellore, Andhra Pradesh, India and maintained in a rearing box by feeding cow dung for further studies. Common weeds such *Azolla* sp. and *Eichhornia* sp. were collected from local ponds located around Annamalai University, Annamalai Nagar, Tamil Nadu, India. The fresh aquatic weed biomass were washed with tap water and chopped into small pieces. The chopped weed biomass were made as a heap individually under shady conditions and decomposing bacterial culture was inoculated (Bacillus sp MTTC No.: 297), and moisture was maintained up to 60% by spraying water regularly. The heaps were turned up 7 days gap to accelerate decomposition and after 30 days, the pre-composted aquatic weed biomass were collected and fed to the earthworms during vermicomposting.

### Preparation of vermicompost

Vermicompost of different aquatic weeds were prepared on clay pots, sized 12 inch height and 9 inch width. The clay pots were filled with sandy soil followed by dried coconut epicarp upto 1/4$^{th}$ of pot height for providing shelter to earthworms. The pre-composted aquatic weed biomass of *Azolla* and *Eichhornia* were mixed with 30 days old cow dung at 4:1 ratio and filled in the pots up to top individually with uniform biomass weight. Simultaneously, only cow dung also filled in pots as control. Moisture was adjusted to 60% and 50 numbers of adult earthworms (*Eudrilus eugeniae*) from rearing box were transferred to each vermipots and covered with jute gunny sheets, and kept under complete shade. Moisture of the earthworm feed mixture was maintained between 50-60% by spraying water regularly. The formation of vermicasting was observed after one week from the date of introducing earthworms. The number of days for 100% conversion of filled feed material into vermicastings was recorded. The vermicastings were harvested, and stored for further studies. The harvested vermicomposts were analyzed for physical and chemical properties such as pH, electric conductivity, organic carbon, nitrogen, phosphorous, potassium, calcium, magnesium, sodium, chloride, sulphate and carbon and nitrogen ratio at Department of Soil Science, Tamil Nadu Agriculture University, Coimbatore, India.

A pot experiment was conducted at Botanical Garden, Annamalai University, Annamalai nagar Tamil Nadu during December, 2011 to June, 2012. Experiment was laid out in randomized design with three replications. Altogether there were 12 pots, three replicates in each for control, cow dung vermicompost (CV), *Azolla* vermicompost (AV), Eichorrnia vermicompost (EV). Egg plant (*Solanum melongena* L.) was grown as test crop. 20 days old eggplant seedlings of local variety planted in pots and applied different vermicompost as uniform dosage by soil application. Treatments consisted of $T_1$-control with 100% recommended dose of inorganic NPK; $T_2$-cowdung vermicompost supplemented with 50% NPK; $T_3$-*Azolla* vermicompost supplemented with 50% NPK; $T_4$–Eichorrnia vermicompost supplemented with 50% NPK. Inorganic NPK was applied through urea, single super phosphate (SSP) and muriate of potash (MOP). Inorganic NPK and vermicompost were applied to egg plant by soil stench method at the time of planting and 40$^{th}$ day, and 80$^{th}$ day from the date of planting.

### Analysis of physico-chemical and biological properties

Soil samples were collected from each pot from 0-15 cm depth in two different periods: Initial pot soil mixture before planting of eggplant seedlings and pot soil after final harvesting of fruits were analyzed for soil pH, electrical conductivity, organic carbon, available nitrogen, phosphorus and potassium at soil testing laboratory, Department of agriculture, Cuddalore, Tamil Nadu, India.

### Growth and yield parameters of egg plant

The plant height, number of leaves per plant was recorded at 20$^{th}$ day, 40$^{th}$ day and 80th day from the date of planting. The number of days for flowering, number of fruits per plant, fruit length and width were recorded. The results were statistically analyzed.

## Results and Discussions

Table 1 shows the physical and chemical properties of different vermicompost. There were significant differences in each physical and chemical properties of the prepared aquatic weeds vermicompost. The chemical analysis of experimental soil has presented in table 2. *Azolla* vermicompost shows high value in both pH (6.9) and electrical

| S.NO. | PARAMETERS | CV | AV | EV |
|---|---|---|---|---|
| 1. | pH | 6.6 | 6.9 | 6.8 |
| 2. | Electric conductivity | 1.68 | 2.85 | 2.24 |
| 3. | Organic carbon (%) | 12.40 | 18.50 | 16.40 |
| 4. | Nitrogen (%) | 0.62 | 1.12 | 0.96 |
| 5. | Phosphorous (%) | 0.50 | 0.65 | 0.32 |
| 6. | Potassium (%) | 0.54 | 0.62 | 0.74 |
| 7. | Calcium (ppm) | 295 | 385 | 410 |
| 8. | Magnesium (ppm) | 113 | 102 | 202 |
| 9. | Sodium (ppm | 45 | 85 | 73 |
| 10. | Chloride(ppm) | 32 | 66 | 48 |
| 11. | Sulphate (ppm) | 10 | 12 | 15 |
| 12. | C/N ratio | 20:23 | 26:32 | 27:26 |

Data represents mean value of three determinations
CV=Cow dung vermicompost; AV=*Azolla* vermicompost; EV=*Eichorrnia* vermicompost

**Table 1:** Physical and chemical properties of different vermicomposts.

| S.No | Parameters | Before planting | After harvest | | | |
|---|---|---|---|---|---|---|
| | | | $T_1$-control | $T_2$-CV | $T_3$-AV | $T_4$-EV |
| 1. | pH | 7.1 | 6.8 | 7.2 | 6.9 | 7.1 |
| 2. | EC(mmhos/cm/25°C) | 1.34 | 1.21 | 1.31 | 1.15 | 1.13 |
| 3. | Organic carbon (%) | 0.65 | 0.52 | 0.78 | 0.72 | 0.68 |
| 4. | Available nitrogen(mg/100 gm soil) | 124.23 | 87.35 | 112.43 | 120.12 | 118.23 |
| 5. | Available phosphorus(mg/100 gm soil) | 8.23 | 7.65 | 7.85 | 7.21 | 7.24 |
| 6. | Available potassium(mg/100 gm soil) | 0.78 | 1.87 | 1.56 | 1.34 | 1.25 |

Data represents mean value of three determinations.

**Table 2:** Chemical analysis of the experimental soil.

| S. No | Treatments | Plant height (cm) | | | Number of leaves per plant | | |
|---|---|---|---|---|---|---|---|
| | | 20th day | 40th day | 80th day | 20th day | 40th day | 80th day |
| 1. | $T_1$-Control | 6.42 ± 0.031 | 13.45 ± 0.040 | 24.26 ± 0.097 | 5.31 ± 0.021 | 12.35 ± 0.061 | 20.34 ± 0.081 |
| 2. | $T_2$-CV | 8.01 ± 0.032 | 17.9 6± 0.071 | 29.12 ± 0.087 | 5.72 ± 0.017 | 15.45 ± 0.046 | 24.55 ± 0.073 |
| 3. | $T_3$-AV | 9.12 ± 0.027 | 20.24 ± 0.101 | 32.56 ± 0.162 | 6.05 ± 0.030 | 18.12 ± 0.054 | 28.32 ± 0.141 |
| 4. | $T_4$-EV | 8.75 ± 0.043 | 19.22 ± 0.057 | 30.34 ± 0.151 | 5.82 ± 0.023 | 16.78 ± 0.083 | 26.05 ± 0.078 |

Values are mean ± SD; sample size (n)=6

**Table 3:**The effect of different vermicomposting on plant height and number of leaves per plant at 20th day, 40th day and 80th from the date of planting.

| S.No | Control | Number of days for flowering | Number of fruits per plant | Fruit length (cm) | Fruit width (cm) |
|---|---|---|---|---|---|
| 1. | $T_1$-Control | 72.65 ± 0.363 | 8.34 ± 0.033 | 6.21 ± 0.031 | 3.85 ± 0.011 |
| 2. | $T_2$-CV | 65.86 ± 0.263 | 10.35 ± 0.031 | 7.85 ± 0.030 | 4.17 ± 0.016 |
| 3. | $T_3$-AV | 63.25 ± 0.189 | 14.12 ± 0.070 | 9.05 ± 0.027 | 5.25 ± 0.026 |
| 4. | T4-EV | 64.56 ± 0.322 | 12.85 ± 0.064 | 8.12 ± 0.032 | 4.75 ± 0.023 |

Values are mean ± SD; sample size (n)=6

**Table 4:** The effect of different vermicomposting on number of days for flowering, number of fruits per plant, fruit length and width.

conductivity (2.85). The maximum percentage of organic carbon was observed in AV (18.50%) followed by EV (16.40%) compared with control (12.40%). The major macronutrients of nitrogen and phosphorous were high in AV (1.12 % and 0.65%) followed by EV (0.96 % and 0.32%). But the potassium content of 0.74% was observed as high in EV than AV (0.62%).

The application of different vermicompost such as CV, AV and EV showed significant difference in vegetative parameters of brinjal, observed at 20th, 40th and 80th day from date of planting. Table 3 shows the effect of different vermicompost on plant height and number of leaves per plant as 20th day, 40th day and 80th day. The maximum value of plant height and number of leaves per plant were observed in plants treated with AV followed by EV and CV. The present reports is an agreement with the reports of Abdullah Adil Ansari and Kumar Sukhraj [15] who found that the availability of macronutrients and micronutrients in vermicompost and vermiwash enhanced plant growth and yield in Okra.

Table 4 exhibits the effect of different vermicompost on number of days for flowering, number of fruits per plant, fruit length and fruit width. There was significant difference in number of days of flowering. It was observed that the number of days for flowering reduced to 63.25 days in AV when compared to EV (64.56) and CV (65.86). But the maximum number of days (72.65) for flowering was recorded in untreated plants (control). Gorakh Nath et al. [16] reported that the application of vermicompost of different animal and agro waste along with neem oil/garlic/custard apple reduced the number of days for flowering in brinjal. The highest fruit yield per plant was observed in AV (14.12) followed by EV (12.85), CV (10.35) and Control (8.34). The maximum value of fruit length was recorded in AV treated plants (9.05cm) compared to plants treated with EV, CV and untreated control. The similar trend of fruit length was observed in fruit width of brinjal treated with different vermicomposts. Moranditochaee et al. [4] reported that the application of vermicomposting increases growth and yield parameters of eggplant in general. Several workers were reported that application of vermicomposting because of supplying optimum nourishment condition caused to improve growth, yield and yield components in crops [17-19]. Similarly, Nuruzzaman et al. [20] observed significant increase in growth and yield parameters of Okra when applied biofertilizers with cowdung.

Agriculture in modern times is getting more and more dependent upon the steady supply of artificial fertilizer with the introduction of green revolution technologies. [13]. Vermicompost is one of the best organic manure in increasing the crop yield; they aerate and fragment the substrate there by drastically altering the microbial activity. But the nutrient status of produced vermicompost differs on the type of biodegradable waste usage during vermicomposting. It results variations in plant response such as growth and yield parameters when it is applied. The application of organic fertilizers has an emphatic effect on plant growth and production [21]. The soil enrich with vermicompost provides additional substances that are not found in chemical fertilizers [14]. Nowadays, it is difficult to manage the aquatic weeds in lotic and lentic types of water bodies. So the present investigation proves that the conversion of aquatic weed biomass into vermicompost is an effective eco-friendly technology for not only managing the rapid growth of aquatic weeds but also can fertilize the crops for sustainable production, particularly vegetable crops.

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