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# Response of Eggplant (*Solanum melongena L.*) To Integrated Nutrient Management Amended Soil

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**Abstract -**In the present study, the effect of different organic manures and inorganic fertiliser levels in soil were observed on growth performances and yield of eggplant. Weeds play a major role in reducing the yield of crops in the field. Therefore this study aimed to use the most popular weed –*Parthenium hysterophorous* which was converted to vermicompost and used as a source of organic manure. The impact of the manures and the fertilisers on the plant height, number of fruits/plant, yield per plant, total protein content, total free amino acids and total carbohydrate contents of the plant were studied. The observations were recorded at three important growth stages namely, vegetative growth-30 DAS, flowering – 60 DAS and fruiting stage – 90 DAS. The perusal of the data revealed that Parthenium Vermicompost applied at 5t/ha either individual or in combination with FYM or 50% RDF of chemical fertilisers enhanced the growth, yield and food quality of eggplants.

**Keywords**- Total Protein Content, Total Carbohydrate Content, Total Free Amino Acids, *Solanum melongena, Parthenium hysterophorous,* plant growth, yield.

## INTRODUCTION

Brinjal (*Solanum melongena* L.) popularly known as egg plant belongs to family Solanaceae and India is its center of origin and diversity (Vavilov, 1931 and Bahaduri, 1951). It is a popular and principle fruit vegetable grown in India and other parts of tropical and subtropical world but in temperate regions, it is grown mainly during warm season (Rai *et al.,* 1995). Apart from India, the other major brinjal growing countries are China, Turkey, Japan, Italy, Indonesia, Iraq, Syria, Spain and Phillippines. Across the globe, it is grown annually on 1.50 million ha area contributing 25.07 million tones with 16.67 tonnes per ha as productivity (Anonymous, 2004). Asia is the main producer, in particular China (53% of the world production), India (28%) and Turkey (4%). (Daunay, M.C et al., 2001).It is highly productive and usually finds a place as "poor man's crop". Brinjal is used in a variety of culinary preparartions since ancient times. It is a staple vegetable in many tropical countries. Purple fruits have higher aminoacid content. Brinjal fruits aves have medicinal properties.(S.Rajan & Baby Lissy Markos,2002).


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Now-a-days demand for brinjal as a fruit vegetable is increasing rapidly among the vegetable consumers in view of its better fruit colour, size and taste. Average productivity of brinjal crop is quite low and there exists a good scope to improve its average productivity in India and Karnataka in particular to fulfill both domestic and national needs. The productivity of brinjal can be increased by using several techniques *viz.,* Organic farming, Integrated Nutrient Management and good hybrid seeds.Since the nutrient turnover in soil plant system is considerably high in intensive vegetable cultivation, neither the chemical fertilizer nor the organic manure alone can help achieve sustainable production (Khan et al., 2008). In these context and as a further response to economic recession and also for the soil fertility conservation and improvement, the approach of integrated nutrient management (INM) has been proposed.

Optimum rate of manure application for vegetables provides better agronomic and economic benefits to vegetable growers. The optimum rate can be calculated based on soil analysis and the nutrient needs of the crop. Soil analysis provide a better understanding of what and how much to allocate for fertilizer inputs considering the high cost of fertilizer and the limited financial resources of vegetable farmers.

The vermitechnology is the latest aspect of biotechnology where application of earthworm is made for combating the waste disposal problem for minimizing the

pollution effect. It helps in cost effective and efficient recycling of animal wastes, agricultural residues and industrial wastes using low energy (Jambhekar, 1992) and to get a useful product called Vermicompost. Its uses as a source of organic manure in supplementing chemical fertilizer is becoming popular among the farmers of the country, increase in crop yield (Nainawat and Bhardwaj, 2003) and nutrient uptake was reported by Bhawalkar and Bhawalkar, 1993 due to application of Vermicompost.

According to Graff (1970), the earthworm castings enrich the plant nutrients in soil. Nielson (1985) has reported the presence of plant growth promoting compounds, synthesized by the earthworms and secreted by them into their cast and thus into soil (Salroo et al., 2002 and Yasari, 2006). Although a lot of work has done in this regard but still attempt has not been made to assess the integrated effect of parthenium vermicompost, FYM and inorganic fertilizers on growth, Yield and quality of eggplant.

## MATERIALS & METHODS

The present investigation was carried out in the botanic research garden of CMS College of science and commerce, Coimbatore during September'09 - December '09 to assess the integrated effect of parthenium vermicompost, farmyard manure and inorganic fertilizers on growth, yield and quality of the vegetable crop, *Abelmoschus esculentus*. The seeds selected for the study was cv. Co 2 . The average day and night temperatures were 37°C ± 2°C and 23°C ± 1° C respectively. The relative humidity was recorded as 35% - 50%.The experiment was conducted by using pot culture method with three replications and nine different treatments along with a control. Polyethene bags [32 x 24 cm] were used for raising the crops. The bags were filled with 5 Kg of soil which was evenly mixed with the manures and fertilizers as per the following treatment schedule:

C = Control

T1= 100% RDF(100kgN : 60kg P : 40 kg K /ha)

T2= 100% FYM @ 12.5t/ha

T3= 100% PV @ 5t/ha

T4= 50% PV @ 2.5t/ha +50% FYM @ 6.25 t/ha

T5= 50% PV @ 2.5t/ha + 50% RDF

T6= 75% PV @3.75t/ha +25% RDF

T7= 50%FYM @ 6.25t/ha + 50% RDF

T8= 75% FYM @ 9.4t/ha + 25% RDF

T9= 50% PV@2.5t/ha+ 25% FYM@3.13t/ha+25% RDF

The position of each bag was randomized at four days intervals so as to ensure uniform enviromnmental impact on the plants growth. Ten seeds were sown at a depth of 1.5cm in each bag. The seedlings were thinned to three per bag on the 10 DAS. The weeds were removed regularly and watering was done once in two days.

Plants from each treatment were randomly drawn for various analyses. Plants from the bags were uprooted carefully and washed in tap water. They were then processed for different analyses. Triplicate samples were used for all the parameters and the mean values were presented.

All the parameters such as growth, yield, Total protein, Total free aminoacids and Total carbohydrates were analysed at three different growth stages such as 30 DAS, 60 DAS & 90 DAS in leaf samples.

### Biochemical changes:

To study the biochemical changes in the level of total soluble proteins, total amino-acids, and carbohydrates leaf of plant was assayed from each treatment in each replication at three different growth stages ,30DAS, 60DAS and 90DAS.

**Total soluble protein:** Proteins were estimated according to the method described by Lowry *et al*. (1951). Fresh leaves were chopped into tiny pieces. The pieces were freezed over night in an extracted phosphate buffer (pH 7) for extraction. Two tubes containing 0.05 mL and 0.1 mL of leaf extract were prepared for protein estimation. 0.05, 0.1, 0.2, 0.4, 0.6 and 1.0 mL of standard BSA were simultaneously used in the experiment. The volume of each tube was made up to 1.0 mL with distilled water. The blank contained only 1ml distilled water. 1ml of solution [50ml of solution (2 g $Na_2CO_3$ , 0.2 g NaOH, and 1 g Na-K tartrate dissolved in distilled water and volume made up to 100 mL) and 1.0 mL of another solution (0.5 g of $CuSO4.5H_2O$ dissolved in distilled water and volume made up to 100 mL) to prepare alkaline copper solution. The tubes were thoroughly mixed and allowed to stand for 10 minutes at room temperature. Then 0.1 mL of 1:1 diluted Folin-phenol reagent was added, mixed well and kept for 30 min at room temperature. The optical density (O.D) was measured at 620nm on Spectrophotometer (Hitachi U- 2000).

**Total free amino-acids.** Total free amino–acids were determined by the method described by Hamilton and Van Slyke (1943). For the estimation of total free amino– acids 1ml of each sample as extracted for the soluble proteins were taken in culture tubes and 1 mL of 10% pyridine and 1 mL of 2% ninhydrin solution were added into each tube. The tubes were heated in boiling water bath for about 30 min. The contents of each tube were then made up to 50 mL with distilled water. The optical density of these coloured solutions were then read at 570nm using Spectrophotometer (Hitachi U- 2000) and total free amino–acids were calculated by the formula given below.

**Total Free amino acids** = Reading of sample .Volume of sample.Dilution factor

(mg / g fresh weight) Weight of fresh tissues. 1000

**Carbohydrates.** Soluble sugars were estimated following Malik and Srivastava (1985). For estimation of soluble sugars, 0.1 g of well ground dry material was homogenized and centrifuged at 1000 g × 29 °C. The residue was retained which was repeatedly washed with 80% ethanol to remove all the traces of soluble sugars. The filtrate thus obtained was used for the determination of soluble sugars, then the volume of the sugar extracts was made up to 100 mL by the addition of distilled water.

**Preparation of anthrone solution**

1 0.4 g of anthrone and 200 mL analar $H_2SO_4$ were taken in 250 mL volumetric flask.
2 60 mL distilled water and 15 mL ethyl alcohol 95% was taken in 500 mL flask.
3 The large flask was placed in ice and poured the solution (1) into (2) slowly with constant stirring by means of an electromagnetic stirrer.

**Preparation of glucose solution.** 0.2 g glucose was taken in a volumetric flask of 100 mL. The volume was made up to 100 mL. 5 mL of this solution was diluted to 100 mL by adding 95 mL distilled water.

**Preparation of blank solution.** 1 mL distilled water taken in a test tube and then added 10 mL of anthrone solution. The tube was covered with cap and shaken at room temperature.

**Preparation of anthrone and glucose solution.** 1 mL glucose + 10 mL of anthrone solution was taken in a test tube and shaken as usual.

**Preparation of sample solution.** 1 mL sample solution + 10 mL of anthrone was taken in a test tube and shaken. All the tubes were heated in boiling water for 12 min, cooled and absorbance was read at 625nm.

***Total soluble sugars were calculated by the following formula:***

**Total Soluble Sugars** = Conc. Of glucose solution . Absorbance of sample. Dilution factor

(g / 100 g of dry weight) Absorbance of glucose

### Soil Analysis

Soil analysis were done at pre and post harvest stages for their available nitrogen, phosphorus and potassium content by following Subbaiah and Asija(1956), Olsen et al., (1954), Stanford and English,(1949) respectively.

### Statistical Analysis

Data for all attributes were subjected to statistical analysis – ANOVA using Agres version 3.01 software to find the significant difference in the parameters studied between various treatments.

## RESULT AND DISCUSSION

The integrated effects of Parthenium vermicompost, Farmyard manure and chemical fertilizers on growth, yield and quality of eggplant have been tabulated along with statistical data. The chemical properties of the soils used in the experiment gave the idea about the fertility of the soil (Table 1). Initial soil pH of 7.2 was favorable for nutrient availability. The pH of the soil has no significant changes after harvest. Generally, the chemical properties of the soils are favorable for crop

growth. The available nitrogen and phosphorous levels in the post harvest soil samples were higher than the pre harvest samples. This was in accordance with the following findings. The increase in the nitrogen content of the post harvest soil sample treated with parthenium vermicompost might be due to the release of more of nitrogenous substance in the soil. Rosaiah et al., (1995) also observed an increase in the available status of nitrogen and phosphorous in soil after crop harvest over the initial status. Subehia and Minhas in 1993, reported that in the post harvest soil the available potassium level was low, because of the intake of potassium by the crops.

**Table 1: Soil Analysis of the experimental field at pre & post harvest periods.**

| Treatments | pH | N (kg/ha) | P (kg/ha) | K (kg/ha) |
|---|---|---|---|---|
| **Pre Harvest Soil Sample** | 7.2 | 195.0 | 11.2 | 119.3 |
| **Post Harvest Soil Sample** | | | | |
| C = Control | 7.0 | 163.4 | 11.0 | 93.3 |
| T1= RDF(100kgN : 60kg P : 40 kg K /ha) | 7.1 | 190.3 | 11.8 | 96.2 |
| T2= FYM @ 12.5t/ha | 7.0 | 197.1 | 12.1 | 95.0 |
| T3= PV @ 5t/ha | 7.1 | 201.2 | 14.3 | 95.2 |
| T4= PV @ 2.5t/ha + FYM @ 6.25 t/ha | 7.1 | 210.3 | 14.5 | 102.1 |
| T5= PV @ 5t/ha + 75% RDF | 7.0 | 192.0 | 12.8 | 95.2 |
| T6= PV @ 5t/ha + 50% RDF | 7.1 | 218.5 | 15.4 | 98.4 |
| T7= FYM @ 12.5t/ha + 75% RDF | 7.0 | 185.3 | 13.2 | 89.4 |
| T8= FYM @ 12.5t/ha + 50% RDF | 7.0 | 181.5 | 14.0 | 90.2 |
| T9= PV @ 2.5t/ha+FYM @6.25 t/ha+50% RDF | 7.1 | 178.3 | 13.6 | 93.1 |

To assess the growth trend, total plant height was measured (Table 2) and it was found to be ranging in between 11.5 to 16.2 cm in 30 DAS, 22.5 to 27.5 cm in 60 DAS and 37.0 to 43.0 cm in 90 DAS. The maximum height was recorded in T6 (PV @ 5t/ha + 50% RDF) followed by T5 (PV @ 5t/ha +75% RDF)in all three stages. This might be due to better moisture holding capacity and supply of micronutrients, macronutrients to the soil by the application of parthenium vermicompost. This is in agreement with the findings of Reddy et al., 1998 and Maske et al., (1997). Similarly, Abusaleha and Shanmugavelu (1988) also reported that the use of poultry manure as a source of N from organic manure combined with inorganic fertilizers enhanced some growth characters of okra.

To compare the yield of the plant, average fruit weight and total yield per plant was observed (Table 2). The average fruit weight was found to range between 20.4 to 35.0g at 60DAS and 20.6 to 35.4g at 90 DAS. There was no significant difference in the age factor but there was a significant difference among the various treatments at CD (0.05). The maximum fruit weight was recorded in T4 (PV@2.5t/ha + FYM@6.25t/ha)

which was at par with T3(PV@5t/ha) and T6(PV@5t/ha + 50% RDF). The yield per plant also recorded the same hierarchy ranging between 143.5 to 478.7g per plant.This might be due to parthenium vermicompost application. This is in accordance with the result by Joshi and Kelkar (1995) who reports that the earthworm cast is

one of the most useful and active agent in introducing suitable chemical, physical and microbiological changes in soils and there by directly increasing soil fertility and crop production.

**Table 2: Effect of different manure and fertilizer combination on Growth and Yield characters of *Solanum melongena***

| Treatments | Plant Height (cm) | | | Average Fruit Weight(g) | | Total Yield / Plant (g) |
|---|---|---|---|---|---|---|
| | 30DAS | 60DAS | 90DAS | 60DAS | 90DAS | |
| C = Control | 11.5 | 22.5 | 37.0 | 20.4 | 20.6 | 143.5 |
| T1= RDF(100kgN : 60kg P : 40 kg K /ha) | 14.3 | 24.0 | 39.1 | 20.8 | 20.8 | 131.0 |
| T2= FYM @ 12.5t/ha | 14.7 | 25.8 | 40.7 | 23.3 | 22.9 | 161.7 |
| T3= PV @ 5t/ha | 13.8 | 25.3 | 40.3 | 30.2 | 29.9 | 331.1 |
| T4= PV @ 2.5t/ha + FYM @ 6.25 t/ha | 14.0 | 25.2 | 40.0 | 35.0 | 35.4 | 478.7 |
| T5= PV @ 5t/ha + 75% RDF | 16.5 | 27.2 | 42.5 | 24.1 | 24.3 | 152.5 |
| T6= PV @ 5t/ha + 50% RDF | 16.2 | 27.5 | 43.0 | 32.6 | 32.0 | 387.6 |
| T7= FYM @ 12.5t/ha + 75% RDF | 11.5 | 23.1 | 37.6 | 21.0 | 21.6 | 183.2 |
| T8= FYM @ 12.5t/ha + 50% RDF | 12.4 | 24.3 | 39.5 | 26.2 | 26.6 | 219.1 |
| T9= PV @ 2.5t/ha+FYM @6.25 t/ha+50% RDF | 15.5 | 25.0 | 40.1 | 20.5 | 20.3 | 114.2 |
| **SED**<br>**CD (0.05)** | **a** t** at****<br>**0.0408 0.0745 0.1290**<br>**0.0816 0.1491 0.2583** | | | **$a^{NS}$ t** at ****<br>**0.045 0.101 0.143**<br>**0.091 0.205 0.290** | | |

DAS- Days After Sowing

To evaluate the variation in food quality, the total protein content (Table 3) was measured both in leaf and fruit samples which was found to be varying from 3.98 to 6.34 g% at 30DAS, 4.13 to 6.53 g% at 60 DAS and 4.10 to 6.36 g% at 90 DAS in leaf samples. The maximum protein content was recorded in T4 (PV 50%@ 2.5t/ha + FYM 50% @6.25t/ha) which was at par with T3 (PV 100% @ 5t/ha). This result correlated with the earlier findings that there was an increase in protein content of vegetable crop by application of FYM along with other organic manures (Bhadoria et al, 2002).

The total free amino acid content is given in table 3. The level of total free amino acids ranged between 0.31 to 1.71 mg/g at 30DAS, 0.81 to 2.38 mg/g at 60 DAS and 0.58 to 2.01 mg/g at 90DAS in leaf sample. The maximum result was recorded in T5 which recieved parthenium vermicompost and chemical fertilizer which was statistically at par with T7 (FYM @12.5 t/ha + 75% RDF. There was a significant difference among the treatments at CD (0.05). There was a decrease in total free amino acid content in T3 & T4 which received parthenium vermicompost alone and along with Farmyard manure respectively. This was in accordance with Pandey and Palani, 1997 who showed that

the decrease in the amino acid content might be due to the presence of sesquiterpene in *parthenium hysterophorus*.

The total carbohydrates (Table 3) was ranging between 5.20 to 7.92 g% at 30DAS, 5.81 to 8.21 g% at 60DAS, 5.41 to 8.01g% at 90DAS in leaf samples.T3(PV @ 5t/ha) showed maximum carbohydrate content which was at par with T6(PV @ 5t/ha + 50% RDF). Our findings are also in agreement with the findings of Nainawat and Baradwaj (2003) who observed that the farmyard manure along with vermicompost increases the growth and yield of the plant. Increased vegetative growth and balanced C:N ratio due to organic manure might have increased the synthesis of carbohydrates which ultimately promoted greater yield of vegetable fruits. Similar opinion has been expressed by Yadav et al. (2004).

**Table 3: Effect of integrated nutrient management on food quality of *Solanum melongena***

| Treatments | Total Soluble Protein (g%) | | | Total Free Amino Acid (mg/g) | | | Total Carbohydrates (g%) | | |
|---|---|---|---|---|---|---|---|---|---|
| | 30 DAS | 60 DAS | 90 DAS | 60 DAS | 90 DAS | 60 DAS | 60 DAS | 60 DAS | 60 DAS |
| C = Control | 3.98 | 4.12 | 4.10 | 0.31 | 0.80 | 0.58 | 5.20 | 5.81 | 5.41 |
| T1= RDF(100kgN : 60kg P : 40 kg K /ha) | 4.43 | 4.98 | 4.92 | 0.28 | 0.41 | 0.28 | 5.91 | 6.31 | 6.11 |
| T2= FYM @ 12.5t/ha | 5.32 | 5.43 | 5.40 | 0.23 | 0.35 | 0.20 | 6.42 | 7.13 | 6.98 |
| T3= PV @ 5t/ha | 6.21 | 6.39 | 6.28 | 0.97 | 1.62 | 1.22 | 7.92 | 8.21 | 8.01 |
| T4= PV @ 2.5t/ha + FYM @ 6.25 t/ha | 6.31 | 6.42 | 6.36 | 0.61 | 1.28 | 1.11 | 7.01 | 7.71 | 7.22 |
| T5= PV @ 5t/ha + 75% RDF | 5.68 | 6.10 | 5.91 | 1.71 | 2.38 | 2.01 | 6.81 | 7.52 | 7.23 |
| T6= PV @ 5t/ha + 50% RDF | 5.98 | 6.22 | 6.10 | 1.24 | 1.98 | 1.13 | 7.22 | 7.82 | 7.54 |
| T7= FYM @ 12.5t/ha + 75% RDF | 4.98 | 5.13 | 5.00 | 1.52 | 2.18 | 1.73 | 6.13 | 6.78 | 6.24 |
| T8= FYM @ 12.5t/ha + 50% RDF | 5.13 | 5.28 | 5.12 | 1.35 | 2.01 | 1.88 | 6.34 | 6.92 | 6.16 |
| T9= PV @ 2.5t/ha+FYM @6.25 t/ha+50% RDF | 5.53 | 5.63 | 5.32 | 0.56 | 1.06 | 0.96 | 6.61 | 7.32 | 6.99 |
| **SED**<br>**CD (0.05)** | **a** t** at****<br>**0.013 0.025 0.043**<br>**0.027 0.049 0.086** | | | **a** t** at****<br>**0.003 0.006 0.012**<br>**0.007 0.013 0.024** | | | **a** t** at****<br>**0.006 0.0114 0.0198**<br>**0.013 0.0229 0.0397** | | |

DAS- Days After Sowing

## CONCLUSION

It is concluded that treatment T4 (PV 50%@ 2.5t/ha + FYM 50% @6.25t/ha) & T3(PV @ 5t/ha) proved superior in enhancing the yield and quality of eggplant. From the results it is suggested that either Parthenium Vermicompost alone at 5t/ha or in combination with 50% of FYM at 6.25 t/ha can be recommended for a good yield of okra plants. For those who vote for organic products it proves to be a good manure to enhance the yield as well as a weed control for *Parhenium hysterophorous* by vermicomposting it.

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