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**Research Article**

# YIELD ATTRIBUTES OF BRINJAL PLANT SUPPLIED WITH EARTHWORM PROCESSED DIFFERENT LEAF LITTER: A COMPARATIVE STUDY

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## ABSTRACT

Earthworms are soil invertebrates that play a key role in recycling organic matter. Vermicompost is potential organic manure and is a rich source of major and minor nutrients to plants. In the organic process, earthworms feed on the organic wastes to produce more earthworms. The earthworm Perionyx excavatus have been widely used for vermicomposts. The present investigation was carried out to assess the nutrient status of the vermicomposts from three groups of leaf litter substrates, namely orchard leaf litter, tree and herb leaf litter and were compared with control. The effect of water stress was examined on each of this leaf and also this study examined the relationship of chlorophyll content, nitrogen with relative water content are found in this present investigation. The result showed the nutrient content of the vermicomposts raised from the following plants; *Psidium gujava, Annona squamosa, Musa paradisica, Mangifera indica, Ficus bengalensis, Ficus religiosa, Tectona grandis, Acalypha indica Alium cepa, Ocimum sanctum ,Cassia auriculata* and were compared with the control. It was found that the maximum plant growth and yield was observed with the application of vermicomposts raised from the substrates *Tectona grandis and Psidium gujaiva* and physico chemical factors such as N, P, K, Mg, C, and Ca were found to be comparatively high, out of the eleven substrates studied in the present investigation. The effects of the aforesaid vermicomposts have been studied on the Solanum melongina - height of the plant, number of fruit per plant and weight of the fruits. Hence, it was concluded that these chlorophyll content and relative water content are strongly related to nitrogen concentration, and vermicomposts have higher nutrient content in turn higher yielding in *Psidium gujava* of orchard leaf litter, tree and herb leaf litters have higher nutrient and higher yielding in *Tectona grandis, Ficus bengalensis and Ficus religiosa.*



## INTRODUCTION

Earthworms so far we called as 'farmer's friend can play a vital role in the present situation. Earthworms are soil invertebrates that play a key role in recycling organic matter. Most of the species that are included under genus *Perionyx* shows appreciable prospective to word of organic matter. In the organic process, earthworms feed on the organic wastes to produce more earthworms. The earthworm *Perionyx excavatus* have been widely used for vermicomposts. The environment and eco friendly, vermicomposting technology can very well be accepted for converting these wastes into wealth. Concern about the state of the environment and problems of solid waste destruction are issues that are increasingly demanding attention globally. An immense assortment of organic residues from sources of plant, animal and industrial waste can be composted to progress a stable eco- friendly commodity of utility. A lot of waste material such as tree litter, coffee and tea waste, vegetable waste, etc. litter decomposition being a complicated case involves the moderate transfer of fresh litter of the unmanageable soil organic matter conditioned by edaphic features and biotic promoters and produce one of the most imperative process in the biogeochemical cycle of forest ecosystem (De Catanzaro and kimmins, 1985). The leaves of most trees contain twice as many minerals as mulch (Pandit *et al*., 1989). Since most of the trees are deep rooted, they consume minerals from the soil and a good fraction of these minerals goes into the leaves. The nutrient flowed from the trees to soil via litter. In actual facts, these are the most precious for the huge amount of fibrous organic matter to the soil. Using this prosperous natural fertilizer means less

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dependency on mineral fertilizers and diminish the quantity of these nutrients which are major pollutants invaded local water streams (Reshetiloff, 2005). Leaf litters represent a potential energy resource if they can be accordingly and biologically converted to organic matter. Vermicomposting is an easy and effective way to recycle leaf litter along with bioconversion of organic waste materials into nutritious compost by earthworm activity. In this process worms help in transforming waste into high quality fertilizer (Mall., ka). Leaf water status is intimately related to several leaves physiological variables, such as leaf turgor, growth, stomatal conductance, transpiration, photosynthesis and respiration (Kramer & Boyer, 1995). Monitoring of plant N status to determine the need for topdressings is one option on an improving the congruence between N supply and crop need (Cassman *et al*., 1996). Leaf N and chlorophyll concentrations are important physiological parameters of detecting plant N status (Mae, 1997). Nitrogen exists on organic and inorganic form and the greatest nitrogen content is in seeds, leaves, shoots and roots. Deficiency in nitrogen leads to loss green color in the leaves, decrease leaf areas and intensity of photosynthesis. Understanding the processes that govern N uptake and distribution in crops is of major importance with respect to both environmental concerns and the quality crop products. Nitrogen uptake and accumulation in crops represents two major components of the N cycle in the agro system (GASTAL and LEMAIRE, 2002). (L). Markwell *et al*. (1995) reported a very strong relationship between the Minolta SPAD-502 chlorophyll meters readings and direct measurements of chlorophyll content in corn and soybean *Glycine max* Merr leaves. Since chlorophyll content is usually strongly related to N concentration, these meters can be used as indicators of need for agricultural N application (Schepers *et al*., 1992; Blackmer and Schepers, 1995). Several epigiec earthworms have been identified as debris feeder such can be breeds in large numbers in organic waste resources. Vermicomposting is the bioconversion of organic waste into a bio fertilizer required to earthworm activity. Hence in the present investigation, yield attributes of brinjal plant supplied with earthworms processed orchard leaf litter: A comparative study was studied.

## MATERIALS AND METHODS

### *Collection and Pre Decomposition of Leaf Litters*

The leaf litters were collected in and around the agricultural area of Periyakulam, Theni district. The collected leaf litters (*Musa paradisiaca T1), Annona squamosa (T2), Mangifera indica (T3), Psidium guajava (T4), Figus bengalensis (T5), Tectona grandis(T6), Ficus religiosa (T7), Acalypha indica (T8), Aliumcepa (T9), Ocimum sanctum (T10), Cassia auriculata (T11)*) were dried and allowed to partial decomposition for 10-15 days. Then the waste was mixed with cow dung on the ratio of 3:1 (leaf litter: cow dung).

### *Collection of Earthworm*

The present investigation was carried out in the laboratory for a period of six months. The experimental animal (*Perionyx excavates*) was collected from J.A. College campus, Periyakulam, Theni District. The earthworms were carefully transported to the laboratory along with their native soil in plastic container provided with small holes for ventilation. The earthworms were acclimatized to the laboratory conditions for a period of 15 days before the commencement of the experiment.

### *Preparation of Vermicomposts*

Leaf litter and cow dung were mixed and introduced into standard plastic tubs occupying about 3kg of the materials. Each pre decomposed substrate was mixed with cow-dung in the ratio of 3:1 on dry weight basis along with standard bedding material in separate plastic tubs with the dimension of 51x31x26cm. Vermicomposting was carried out in an environmentally controlled experimental chamber at a temperature of 27°C and the vermin beds were maintained to contain a moisture level of 65-75% by sprinkling water over the outer daily. Each tub containing vermin bed substrate was inoculated with fifty adult epigeic species of earthworms (*Perionyx excavatus).* The culture tubs were placed inside the lab. The upper surface of bedding substantial was covered with black polythene sheets to avoid threshold of other insects.

### *Nutrient Analysis*

Samples from vermin bed substrates and vermicomposts were dried, ground and sieved. The $p^H$ and Electrical conductivity were determined by the method of (Jackson ML, 1973) in a distilled water solution. The determination of organic carbon was carried out as per the procedure of (Walkley and Black 1934) Nitrogen, Phosphorus, Potassium, Calcium, Carbon and Magnesium were determined according to standard methods as described by (Tandon, H.Z. 1993). Leaf chlorophyll content was estimated following (Nanjareddy YA).

### *Leaf Water Status Measurement (RWC)*

Leaf status was evaluated by the method of Weatherly and slayer (30), as described by naidu *et al*., (23). Duplicate 10 cm sections were taken from the midpoint of the number three leaf of a plant. The original weight was determined immediately after harvest, and the tissue was floated in distilled water for 24hours in a closed chamber, at this time, the saturated weight was taken, and the tissue was dried at 800 c for 24 hours for day weight determination, from the data obtained, the percent relative water content (RWC) and water saturation deficit (WSD) water estimated as follows:

$$\%\,\mathbf{RWC} = \frac{\textbf{Fresh weight - Dry weight}}{\textbf{Turgid weight - Dry weight}} \times \frac{100}{1}$$

### *Sapling of Brinjal Plant*

Sapling of brinjal was sown in the plotted fields (864sq.ft) and planted with the sapling. Saplings were planted at a distance with 30cm and were applied to dosages at (200gm/plant) of vermicompost already prepared. All the necessary cultural practices and plant protection measure were followed uniformly for all the treatments for the entire period of experimentation and were replicated in a randomized complete block design. In the experimental plots different vermicompost was added and control plots were maintained without vermicomposts. The extent of plant growth, number of flowers, and number of fruits was studied.

### *Statistical Analysis*

Two way analysis of variance (ANOVA) was performed, using kyPlot (version No.2 beta) to analyze the level of significance of difference between the vermicomposts processed by earthworms, chlorophyll content related with nitrogen, and compost sample with respect to nutrient content (R.A.Fisher).

## RESULTS

In the present investigation, a comparative study was made on the effect of vermicompost raised from four types of orchard leaf litters, and analyzed various physico chemical parameters, such as Electrical conductivity, $p^H$, Nitrogen, Potassium, Phosphorus, Calcium, Megnesium, and Organic Carbon were tested from the vermicomposts.

### *Physicochemical Analysis of Different Leaf Litter Vermicompost*

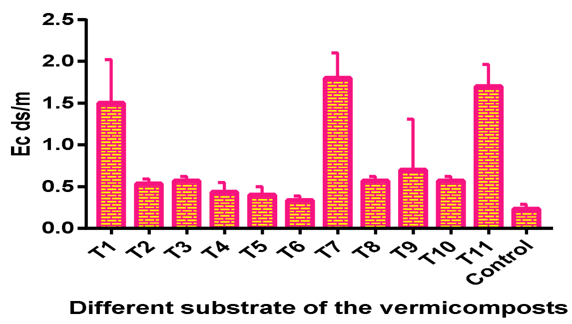
The nutrient status of various leaf litter vermicomposts was analyzed in the present study, including Electrical conductivity, $p^H$, Nitrogen, Phosphorus, potassium, Megnesium, Calcium, and Chloride in the vermicomposts of four orchard leaf litters processed by earthworm species *Perionyx excavatus* during a period of 60days. The $p^H$ was observed in T1 (6.8±0.11), T2 (6.9±0.11) T3 (7.6±0.28) T4 (7.7±0.26) T5 (7.5±0.5), T6 (3.70±0.02) T7(.5±0.5), T8 (7.13±0.23), T9 (7.06±0.11), T10(7.6±0.57), T11 (6.8±0.11) and control (6.6±0.7). The observed data onto the variation in Electrical conductivity T1 (0.4±0.51), T2(0.04±0.11) T3 (0.06±0.1) T4 (0.04±0.05) T5 (0.04±0.05), T6 (0.08±0.11), T7(0.65±0.02), T8 (0.4±0.63), T9 (0.48±0.63), T10 (0.2±0.03), T11 (0.02±0.36) and control (0.04±0.05) The Total Nitrogen (TN) was detected on the $60^{th}$ day of decay be ahead of predating in the experimental and control bedding statistically significant difference was reported in vermicomposts ($p \leq 0.05$). Compared to the control the nitrogen content was found to be high in *T5* (6.06±0.01), *T6* (5.5±0.19), *T4* (4.3±0.28*)*, *T2* (3.70±0.025), *T8* (3.15±0.13), and lower in *T9 (1.3*±0.3) *T11 (1.4*±0.3), *and in control (0.23*±0.05). While comparing *F. bengalensis, T.grandis, P.gujaiva, A.squamosa, A.indica* are greater than *C.ariculata, Acalypha indica and* control. Phosphorous was found to be high in *T7 (17.5±0.5), T6 (15.5±0.5) T4 (14.6±0.4), T2 (14.5±0.5), T3 (15±1) lower in T1, T8(9.1±0.5), T10,T11 and in control (0.7±0.1).* While comparing *F. bengalensis, T.grandis, P.gujaiva, A.squamosa, A.squamosa and M.indica* are greater than *Acalypha indica and in* control. Potassium (ppm) was found to be high in *T6 (0.79±0.005), T5 (0.76± 0.05), T7 (0.66± 0.05), T8 (0.70±005),T9 (0.6±0) lower in T10 (0.01±0),T11 (0.01±0), and in control (0.01±0.005).* While comparing *F. bengalensis, T.grandis, A.cepa, Acalypha indica* are greater than*, O.sanctum, C.ariculata and in* control. The Calcium content was found to be high in *T6(1.73±0.80), T5 (1.63±0.83), T7 (1.7±0.4), T2 (1.83±0.25), and T3 (2.1±0.52), T4 (1.83±0.25) lower in T1, T11 and in control (0.6±0.1).* While comparing *F. bengalensis, T. grandis, M. indica, P.guaiva and A.squamosa* are greater than *Calatrophis, and in* control. The Magnesium was found to be higher in *T6 (19.03±0.47), T5 (17.43±0.70) T7 (18.5±0.43), T2 (14.08±1.21), T4 (12.30±1.3), T1 (16.9±0.65) and T3 (16.9±0.65) lower in T11 (8.76±1.01),) and in control (8.03±1.51).* While comparing *T. grandis, F.religiosa, F. bengalensis, M. indica, Musa, P.gujava and A.squamosa* are greater than *Cassia auriculata and in* control. Chloride was found to be high in *T6 (19.03±0.47), T5 (17.43±0.70), T7 (18.5±0.43), T2 (14.08±1.21), T4 (12.30±1.3), T1 (16.9±0.65) and T3 (16.9±0.65) lower in T11 (8.76±1.01),) and in control (8.03±1.51).* While comparing *T. grandis, F.religiosa, F. bengalensis, M. indica, M.paradisica, P.gujaiva and A.squamosa* are greater than *C.auriculata and in* control. Two way anova variations was calculated between the parameters of the nutrient content of the vermicomposts raised from different orchard leaf litters and the growth and yield of the plant. It was found that highly significant difference in the *** ($P<0.001$) nutrient status. The nutrient status carried out is briefly described in Table 1.

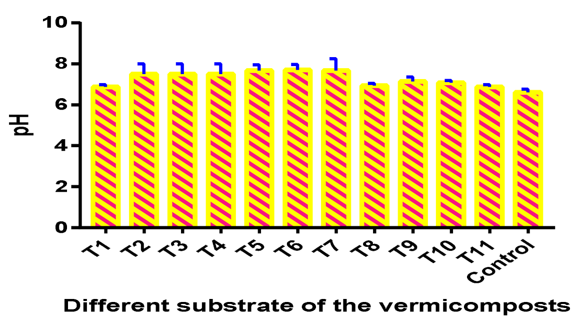
### *Chlorophyll Content*

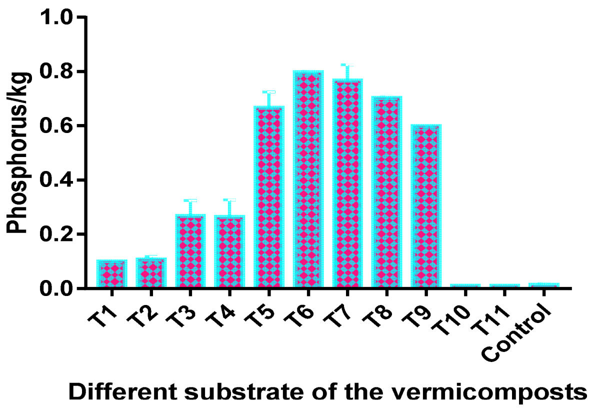
Chlorophyll is called as an essential pigment because it converts light energy into chemical energy. This is necessary for various life processes of plants 2.4, 1.3, 1.5, 1.4, 1.5, 1.0, 2.5, 2.5, 3.25, 2.5, 1.6 and control 0.2 mg g-1. The chlorophyll contents higher in *Ollium cepa* (3.25mg/g), *Tectona grandis* (2.5 mg/g), *Cassia auriculata* (2.5 mg/g), *Osmium sanctum* (2.5 mg/g) *Annona squamosa* (2.4 mg/g) *Psidium gujava* (1.3 mg/g) *Musa paradisiaca* (1.5 mg/g) *Mangifera indica* (1.4mg/g) compared with control (0.5 mg/g). These results are similar to the previous findings of (Chamle D *et al*., 2006) Fig 10.

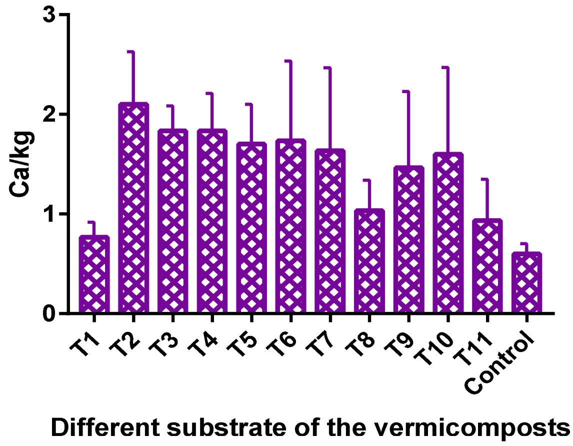
### *RWC*

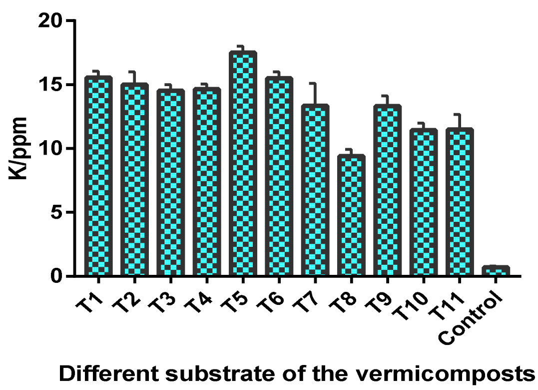
Relative water contents were made on *Psidium gujava, Annona squamosa, Musa paradisica, Mangifera indica, Ficus bengalensis, Ficus religiosa, Tectona grandis, Ocimum sanctum, Acalypha indica, Allium cepa, Cassia ariculata* plants varying levels of N and water stress. The Analysis of variance related that nitrogen and relative water content effects differed, depending on method of chlorophyll determination. The present investigation is result are revealed that the chlorophyll content related to relative water content is may be relationship between the two groups. Analysis of regression is significant **p>0.0 related to chlorophyll and relative water content.

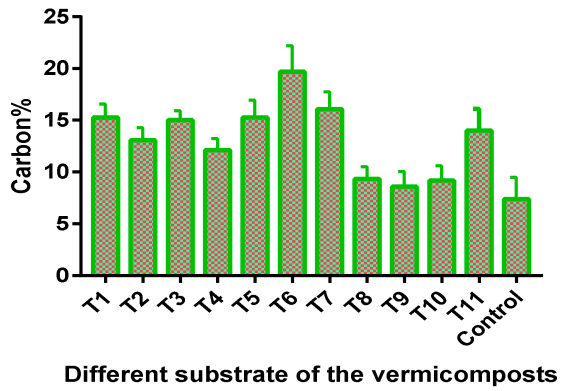


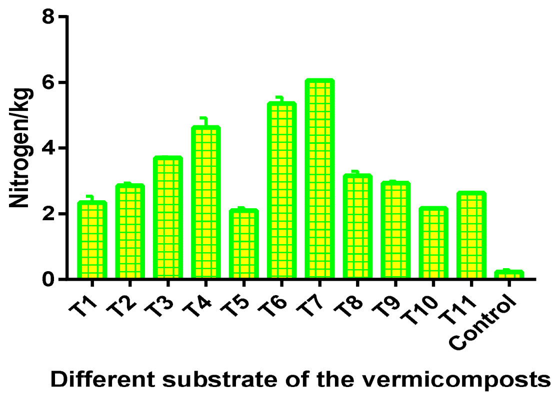





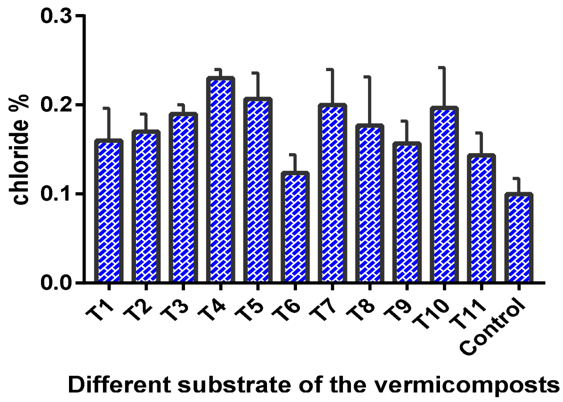
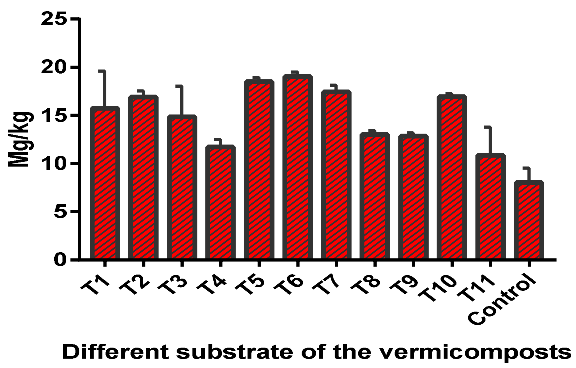




**Figure 1-9** Nutrient analysis of the vermicomposts from various leaf litters



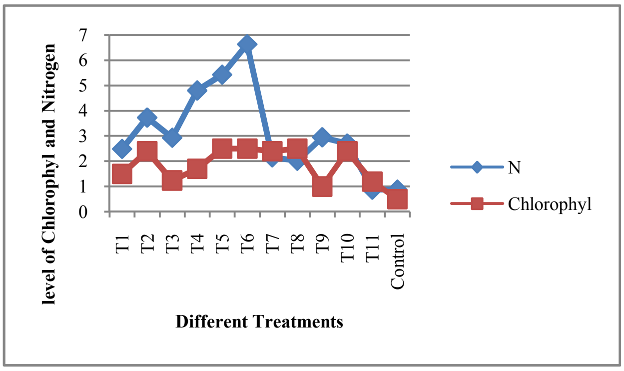




**Figure 10** Analysis of nitrogen related with chlorophyll content

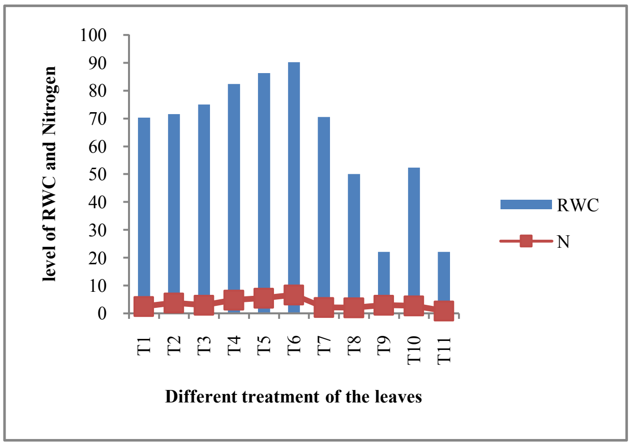



**Figure 11** Effect of relative water content and nitrogen on leaves

present experiment, the parameters such as $p^H$, Electrical conductivity, Nitrogen, Phosphorus, Potassium, Magnesium, Calcium, Carbon, Chloride level were found to be higher in all the experiment with *Tectona grandis, Ficus religiosa, Ficus bengalensis, gujava* vermicomposts followed by *annona squamosa, musa paradisica* and *mangifera indica, allium cepa, ocimum sanctum, cassia auriculata* respectively and to compared with control. Agricultural substrates and wastes are potential sources of organic nutrients which if converted into various manures as compost, vermicompost, dry leaf manure etc. To improve soil and water conservation, sustain crop productivity and enhance crop yields (Hundal and Zinia, 2009). The increased Ec during the period of the composting and vermicomposting process is in consistence with that the earlier workers (Kaviraj *et al*., 2008 and C. D. Jadia *et al*. 2003).

**Table 1** Effect of vermicomposts on plant growth and yield *(Solanum melongena)*

| Substrate | Treatments | Egg plant growth (in cm) | | | | Weight of the fruit (in g) |
|---|---|---|---|---|---|---|
| | | 15th | 30th | 45th | 60th | |
| | T1 | 14.4±0.49 | 21.3±0.9 | 27.2±0.2 | 34.6±1.05 | 30±0.7 |
| | T2 | 10.7±0.44 | 20.7±1.6 | 23.8±1.04 | 29.6±1.05 | 27.4±1.67 |
| Fruit trees-leaf litters | T3 | 14.7±0.49 | 20.4±0.7 | 27.9±0.32 | 34.16±1.6 | 23.6±0.95 |
| | T4 | 15.6±0.53 | 21.2±1.3 | 27.5±0.4 | 35±2.04 | 28.0±1.7 |
| | T5 | 7.6±0.55 | 20.9±1.9 | 38.03±2.9 | 53.7±2.86 | 58.8±4.7 |
| Trees-leaf litters | T6 | 10.7±0.43 | 29.16±1 | 44.6±4 | 61±2.72 | 51.62±1.31 |
| | T7 | 7.63±0.55 | 20.9±1.9 | 30. ±2.9 | 53.7±2.86 | 44.2±3.2 |
| | T8 | 7.6±0.52 | 14.6±0.28 | 22.6±1 | 32.1±0.76 | 33.7±1.62 |
| | T9 | 7.1±0.17 | 15.3±1.07 | 21.3±1.12 | 35±2.79 | 26.8±1.7 |
| Herbs-leaf litters | T10 | 7.3±0.28 | 10.9±0.5 | 20.7±1.36 | 26.4±0.5 | 26.6±2.7 |
| | T11 | 7.4±0.33 | 11±1 | 20.1±1.25 | 26.5±2.56 | 31±1.2 |
| | Control | 7.7±0.61 | 13.4±0.66 | 17.7±0.68 | 22.8±0.8 | 19.1±0.98 |

Two way Anova variations were calculated between the parameters of the nutrient content of the vermicomposts raised from different orchard litter, tree litter and herbs leaf litter and the growth and yield of the plant. It was found that highly significant difference in the nutrient status, following orchard, trees and herbs. Orchards -*Psidium gujava, Annona squamosa, Musa paradisica, and Mangifera indica.* Trees and herbs - *Tectona grandis, Figus religiosa, Ficus bengalensis****** ($P<0.001$). The nutrient statuses carried out are briefly described in figure 1-9.

## DISCUSSION

In the present investigation, analysis of the nutrient contents in the different orchard leaf litter, tree leaf litter and herbs leaf litter vermicomposts produced by earthworm (*Peronyx excavatus*). The Physico chemical analysis of the different vermicomposts and the level of Electrical conductivity, $p^H$, Nitrogen, Phosphorus, Potassium, Calcium, Magnesium, Chloride, Carbon and control on 60th day vermicomposts. In brinjal, the effect of treatment was studied at three different stages of plant growth of 15th, 30th, 45th, and 60th: height of the plant, number of fruit per plant and weight of the fruits were significantly influenced by applying different vermicomposts as on organic sources. The neutralization of the $p^H$ level of the vermicomposts produced in the experiment was great with some orchard leaf litters *gujava* vermicomposts followed *by Annona squamosa, Mangifera indica and Musa paradisica* and tree leaf litter vermicomposts followed by *Tectona grandis, Ficus religiosa, Ficus bengalensis, herbs leaf litter vermicomposts followed by allium cepa, ocimum sanctum, cassia auriculata* respectively and compared to control. In the

The substrate (coffee pulp) having an initial $p^H$ 4.1 was analyzed during vermicomposting using *fetida, P.excavatus* and *E.andrei* and reported that substrate $p^H$ became neutrals (6.5-7.4) on 15th day and then it turned into basic (8-9) for 15 weeks. At the end of the decomposition process, it was found that the substrate in all the treatments was neutral while slightly acidic in control (Salazar, T.C., *et al*., 1995). The increase in leaf RWC with increased nitrogen levels was in line with the observation of clements and Kubota (1942), who reported a close relationship between nitrogen concentration and leaf moisture content in the sugar plant. The report on these authors implied that plants grow under conditions of inadequate nitrogen supply is likely to have low moisture content no matter what the moisture conditions in the soil air (viqueria *et al*., 1983). The total N content represents indicator of N accumulation in plant (DESAI and BATHIA, 1978) which indicating root system activity and translocation of organic and inorganic matter to top of plant. Physiological N efficiency in plant indicating activity of top of plant and involve in absorbed N into processes of synthesis. Leaves exhibit a structural and functional acclimation of the photosynthetic apparatus to the light intensity experienced during their growth (PRIOUL *et al*., 1980). Nitrogen supplied has large effect on leaf growth because it increases the leaf area of plants and, on that way, it influences on photosynthesis. Photosynthetic proteins represent a large proportion to total leaf N (Evans, 1989; Field and Mooney, 1986). Chlorophyll content is approximately proportional to leaf nitrogen content, too (EVANS, 1983). The organic degradable refuse of plant and animal origin have been shown to provide a good source of nutrients to improve productivity (Padmavathiamma *et al*., 2007). The enhancement of nitrogen in vermicomposts was probably due to mineralization of the organic matter containing protein (S. Bansal *et al*., 2000 and A.Singh *et al*., 2002). These reactions take place in the rhizosphere, and because the organisms transfer more P into solution than required for their own growth and metabolism, the surplus is available for plants, thereby increasing the P uptake. The increased P availability due to the increase in solubility of P by higher phosphatase activity by vermicompost application was reported by Syres and Springett (1984). The higher Ca content in vermicomposts compared to that of compost and substrate is attributable to the catalytic activity of carbonic an hydrase present in calciferous glands of earthworms generating CaCO3 on the fixation of CO2 (P. K. Padmavathiamma). The higher concentration of Mg in vermicompost reported to present study was also in consistence with the findings of earlier workers (P. K. Padmavathiamma S. C. Tiwari,). Total organic carbon decreased from the passage of time of vermicomposting and composting processes in both the substrates. Swati Pattnaik and Reddy (2009) was observed the N, P, K, Ca, and Mg contents in vermicompost produced by *P. excavates* increased by 51.1, 76.0, 83.3, 50.0 and 100.0%, respectively and the OC decreased by 50.5%, at 15 days of processing;where as the increase was 137.8, 212.0, 283.3, 648.4 and323.5% and the decrease was 73.1% at 60 days of processing, respectively. These findings are in consistence with those of earlier authors (Garg *et al*., 2005, C. Tognetti, *et al*., 2005). Sundara vadivelen *et al*., 2011 was observed the vermiwash produced from the leaf litter of guava appeared to be the best followed by sapota and mango, various researchers have established the viability of vermitechnology for the treatment of different wastes. The findings of Gopi (2002) who reported that application of vermicompost (1:1:1) as soil mixtures significantly increased the growth and biomass productivity of forest seedlings such as *Tectona grandis, Casuarina equisetifolia, Simarou baglauca, Pongamia pinnata* and *Delo nixregia.* Vermicompost and mycorrhizal consortia recorded maximum total dry matter production in casuarina. This could be due to the richness of applied vermicompost with nutrients and other metabolites. The combined application of mycorrhizal consortia and teak vermicompost recorded higher values for all growth parameters. The NPK level is high in 50:50 concentration compared than other two concentrations and control. The total NPK level is good for plant growth and improvement of soil fertility. *Ficus bengalensis, Ficus religiosa, Tectona grandis, Ocimum sanctum, Acalypha indica, Allium cepa, Cassia ariculata,* is not only medicinal uses always used as a vermicompost production.

## CONCLUSION

The present study were concluded that the bioconversion of orchard, trees leaf letters and herb leaf litters are nutrient rich, vermicomposts compare than control and also this study examined the relationship of chlorophyll content, nitrogen with relative water content are found in this present investigation. The chlorophyll and nitrogen was strong relationship between the chlorophyll content increases in the leaves and also may be increased from the nitrogen level. The vermicomposts produced from the leaf litter was highly significant in the nutrient content, plant growth and yielding to the *Tectona grandis, Ficus bengalensis* and *Ficus religiosa*, appeared to be the best followed by *Psidium gujava, Annona squamosa* and *Mangifera indica* and also highly significant in the plant growth and yield of *Solanum melongena* and low nutrient level in the leaf litter was *Allium cepa,* and *Cassia auriculata*.

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