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Effects of Different Substrates on Vermicomposting Using Eudrilus Eugenia on the Growth of Vinca Rosea

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Abstract- Vermicompost are produced by the breakdown of organic waste which results in rich microbial diversity and it has many nutrients that support the plant growth. Vemicomposting is increasingly popular in diverse aspects including recycling of organic waste, efficient nutrient supplier for plant growth. The present study was conducted to investigate the effect of different substrates such as kitchen waste, coir pith and rice straw on the production of vermicompost. These vermicompost were assessed for nutrient values and subjected to studies on the growth of *Vinca rosea*. The temperature of the composting material ranges from 22° C to 35°C,pH was between 5.5 -9 , moisture content of the composting was recorded as 40% - 56%.The nutrient analysis reported that high amount of Total Organic Carbon(TOC) is in coir pith vermicompost i.e about 0.43% -0.63% ,The total phosphorus and available phosphorus are high in rice straw compost about 0.065 and 0.55% on the 75th day. The total kjedhal nitrogen was about 1.42% in the kitchen waste obtained on the 45th day. The result indicated that vermicompost is a good biofertilizer and showed better growth patterns in *Vinca rosea* cultivated by the vermicompost prepared using coir pith.

I. Introduction

Non-conventional sources of amending organic matter status of soil are acquiring much attention because of their easy availability, prompt response and feasibility in using over large area in less time (Hossein Moradi et al, 2014). But incase of inorganic fertilizer leads to an increased risk of burning the plants, leaching, affects the water tables, build up toxic salt concentration in the soil. Excessive use of inorganic fertilizer creates environment related problems and situation can be improved by biofertiliser (Saadatnia and Riahi, 2009). This problem leads the way for using Vermicomposting (organic fertilizer). India has estimated potential of producing about 4.3 million tonnes of compost each year. Organic matter constitutes 35%–40% of the municipal solid waste generated in India. Composting using worms known as Vermicomposting gives a better product than composting due to enzymatic and microbial activity (Bajsa et al, 2003). Vermicompost is homogenous, contains many plant growth hormones and soil enzymes, which enriches microbial populations and tending to hold more nutrients over longer periods without adverse impacts on the environment (Ndegwa et al, 2001). It has tremendous prospects in converting agro-wastes and city garbage into valuable agricultural input. Vermicast also serves as a very good fertilizer and soil conditioner. The type of substrate and species used for Vermicomposting plays a significant role in plant growth and yield. Most commonly used substrates are cowdung, industrial wastes, agricultural residues etc.. The amount of soil nitrogen increased significantly after incorporating Vermicomposts into soils (Sreenivas, 2000; Kale, 1992; Nethra, 1999) and the amounts of P and K available also increased (Venkatesh, 1998). It has many applications such as increases water holding capacity of soil, improves crop growth and yield, improves physical, chemical and biological properties of soil and production of plant growth regulator. It proves to be the most promising high value biofertilizer, pollution free and cost effective. Earthworms are also multiplied and the excess earthworm can be used as a vermiprotein and used as a feed for poultry, fish etc. Vermiwash can also be used as a spray. In the present study different substrates such as kitchen waste, coir pith, and rice straw were used for preparing the Vermicompost. Their effects were studied as a organic fertilizer in the growth of *Vinca rosea.* Their physiological and nutritive properties of the composted waste was also analysed.

II. Methodology

Sample collection

The substrates for the Vermicomposting such as kitchen waste,Coir pith, Rice straw are collected from Stella Maris Hostel Kitchen, Chennai; Alagar biotech, Vettuvankeni, Uthandi, Chennai; Luz church road, Alwarpet, Chennai respectively.

Experimental setup

The experimental set up has six plastic trays for Vermicomposting with a size of 30 cm × 11 cm × 5 cm and covered with drapery with micro holes. Kitchen waste, coir waste and rice straw were collected. The trays were setup for Vermicompost as follows:

SETUP OF VERMICOMPOSTING TRAYS

Table:1 Setup of Vermicomposting trays

Layer of gravel	Garden soil	Decomposed material	Cow dung	Kitchen waste
Layer of gravel	Garden soil	Decomposed material	Cow dung	Coir pith
Layer of gravel	Garden soil	Decomposed material	Cow dung	Rice straw
Layer of gravel	Garden soil	Decomposed material	Cow dung	Kitchen waste (control)

Layer of gravel	Garden soil	Decomposed material	Cow dung	Coir pith (control)
Layer of gravel	Garden soil	Decomposed material	Cow dung	Rice straw (control)

The composting was prepared using hand sorting method(Walton 1993).The physico-chemical and biological characters were monitored during Vermicomposting at periodic intervals (15 days).

PHYSIOLOGICAL PROPERITIES OF VERMICOMPOSTS

The physical properties of the Vermicompost such as pH, temperature, moisture content was evaluated.5g of soil was weighed which was suspended in 10ml of distilled water, shaken for 30 minutes and $_P$H of the supernatant was measured using pH meter and the temperature was determined using thermometer. The moisture content of the soil was determined by comparing the wet soil with dried soil after 24 hours of incubation. The percentage of moisture content was determined by the formula given below.

% moisture in soil = wet soil- dry soil/dry soil ×100.

NUTRIENT ANALYSIS OF VERMICOMPOSTS

The total organic content in the compost was estimated using Walkey and Black method and it is calculated using the following formula:

% of oxidizable organic carbon = (vol.of.blank- Vol of sample ×0.3 ×molarity)

%Total Organic Carbon w/w = 1.334× %TOC

The nitrogen content was estimated using Kjeldahl method(TKN) and calculated using the following formula:

% of TKN= (S-B)× 0.02 ×(14/amount of sample)

TKN =(S-B) ×0.02× (14/amount of sample)

The phosphorus content was estimated using Oleson method and calculated using the following formula:

$$\text{mg P/L} = \frac{\text{mg P (in approximately 58 mL final volume)} \times 1000}{\text{mL sample}}$$

SEEDLING GROWTH OF *Vinca rosea*

Vinca rosea seeds were inoculated into the labeled trays supplemented with Vermicomposted soil and the biometric parameters such as root length, shoot length and number of leaves were recorded on 10 days intervals. The germination percentage was calculated using the following formula:

$$\text{Germination percentage} = \frac{\text{No of seed germinated}}{\text{No of seed sown}} \times 100$$

Root length was measured from the ground level to the tip of the root (cm) and its shoot length was measured from the ground level to the shoot tip (cm).

III. RESULT AND DISCUSSION

The present study was conducted to evaluate the efficiency of different substrates for preparing Vermicompost and its vital role in supplying essential nutrients that support the plant growth.

Physiological properties of Vermicompost

Earthworms are very sensitive to $_P$H, thus $_P$H of waste is sometimes a factor that limits the distribution, number and species of earthworms. Moisture level and temperature are the significant factor in the setup of a Vermicomposting unit. The different temperatures during composting are illustrated. The maximum temperature was on the 60th day of composting was 35° C and the temperature decreases to 28° C at the end of 75thday. Ansari (2000) reported that temperature during the process of Vermicomposting was observed to be 2 8 .2 6 ± 2 .1 9°C. the study also reported that the $_P$H changes during composting process (60 days). The pH of the Vermicompost was acidic in the earlier stage of decomposting then it becomes neutral and at the end of the 45th day it was basic later it again comes to neutral pH at the 75th day. The percentage of moisture content increases to 56% on the 45th day and then decreases to 45% on the 75th day. Figure 1 shows the physical parameters of the Vermicomposted soil every 15 days at regular intervals.

Nutrient analysis of Vermicomposted soil

Total organic carbon

The highest values of organic carbon of kitchen wastes, coir pith, rice straw were obtained in 45th day and lowest values were obtained on the 15th day of Vermicomposting. Total organic carbon was very high in coir pith showing (0.63 %) compared to other substrates (kitchen waste and rice straw). There has been a report which showed increase in organic carbon of kitchen waste Vermicomposted *E.eugeniae* which was 13.5% (Senthil and Chotu et al., 2008). In the study conducted by Elvira et al observed that about 20 to 42% loss of carbon as CO_2 takes place during vermicomposting of paper mill and dairy sludge. Figure 2 illustrates the total organic carbon of different substrates during Vermicomposting.

Total phosphorus

The total phosphorus content was very high in kitchen waste compared to other substrates. Available phosphorus of the kitchen waste was obtained in 30th day as 0.68% and the lowest values obtained in 15th day as 0.15%. Moreover as the time period increases during Vermicomposting, these parameters also increases Garg et al., (1988). The availability of phosphates was enhanced in vermicasts compared to non- ingested soil (Sharpley and Syers, (1978) due to increased solubility of P by high phosphatase activity. Table I illustrates the total phosphorus content of different substrates at 15 days intervals.

Available phosphorus

Available phosphorus was very high in kitchen waste compared to other substrates. Table II shows the available phosphorus content present in different substrates.

Total kjeldhal nitrogen

The highest values of nitrogen in kitchen was obtained on the 45th day (0.36%) and in the control (0.68%). The nitrogen content in the coir pith was noted to be 0.29% on the 45th day and in the control was found to be 0.52%. The highest values of total kjeldhal nitrogen of rice straw was noted to be 0.11% on the 45th day and in the control was found to be 0.54%.Total kjeldhal nitrogen was very high in kitchen waste compared to other substrates. Increased availability of N in worm casts compared to non- ingested soil has been reported by Tiwari et al., (1989). Bouch et al stated that the worm activity can increase the potential N mineralization rates and it accelerates the transformation of N, after increasing availability

SEEDLING GROWTH OF *Vinca rosea*

The seedling growth of the *Vinca rosea* plant was measured in the control and in Vermicomposted soils. In control, growth of the plant increased from 2 to 7 cm in length. The plants which were grown in Vermicompost soils showed higher growth than the control.

Growth of *Vinca rosea* using kitchen waste as substrate

Height of the root, leaves and stem were measured for the test and control plant seedlings. In test plant, root height increased from 1 to 3.5 cm in length and in the control plant the root height increased from 0.5 to 2.5 cm in length. In test plant, leaves height increased from 0.5 to 3.5 cm and in the control plant the leaves height increased from 0.1 to 2 cm in length. Figure 3 shows the growth of the root of the plant Vinca rosea using kitchen waste as substrate in Vermicomposted soil. Figure 4 illustrates the growth of the stem of the plant Vinca rosea using kitchen waste Vermicompost. Figure5 shows the growth of the leaves of the plant Vinca rosea using kitchen waste Vermicompost.

Growth of *Vinca rosea* using coir pith as substrate

The plant seedlings grown using Vermicompost of coir pith substrate the height of the root,stem and length of the leaves were measured.The growth of the root increased from 1.3cm to 4.5 cm in length for the test and in control it is increased from 0.5 cm to 3.5 cm in length. In test plant, length of the leaves increased from 0.5 to 3.5 cm in length and in the control plant the leaf length increased from 0.1 to 2.7 cm in length.It was found that the length of the stem increases from 2 cm to 7cm in test and 1.5 cm to 4.5 cm in control**.** Figure6 shows the growth of the root of the plant *Vinca rosea* using coir pith substrate as a Vermicompost. Figure7 illustrates the growth of the leaves of the plant *Vinca rosea* using coir pith. Figure8 shows the growth of the stem of the plant *Vinca rosea* using coir pith.

Growth of *Vinca rosea* using rice straw as substrate

It resulted that the root increases from 1cm to 4 cm in length for the test and 0.5 cm to 3.5 cm for the control. The leaves length increases from 0.5 cm to 3.5cm in length for the test and 0.1cm to 2.6cm for the control and the stem height increase from 2.5cm to 6.5cm in length for the test and 1.5cm to 3.5cm for the control. Figure 9 shows the growth of the root of the plant *Vinca rosea* using rice straw substrate as a Vermicompost. Figure10 illustrates the growth of the leaves of the plant *Vinca rosea* using rice straw. Figure11 shows the growth of the stem of the plant *Vinca rosea* using rice straw as a substrate.

Growth of the plant *Vinca rosea* on different Vermicomposted substrates showed that height of the root, leaves and stem in kitchen waste found that the maximum growth reaches to 3.5 cm in length. In coir pith were the maximum growth reaches to 7 cm in length compared to rice straw the maximum growth reaches to 6.5 cm in length.

Plants grown by the application of Vermicomposted coir pith in different feed ratios with cow dung by both species of earthworms showed efficient growth than the control Vermicompost with only coir pith as substrate (Dash and Patra 1997). The present work also proved that the coir pith served as a better substrate in increase on the growth of root, height and leaves compared with kitchen waste and rice straw.

Table I Total phosphorus content of different substrates at 15 days intervals.

NO.OF.DAYS	KITCHEN WASTE	COIR PITH	RICE STRAW
0	0.001	0.001	0.001
15	0.020	0.018	0.022
30	0.032	0.026	0.031
45	0.046	0.038	0.043
60	0.058	0.049	0.057
75	0.061	0.057	0.065

Table II phosphorus content present in different substrates at 15 days interval.Available

NO.OF.DAYS	KITCHEN WASTE	COIR PITH	RICE STRAW
0	0.15%	0.10%	0.12%
15	0.24%	0.18%	0.22%
30	0.26%	0.20%	0.27%
45	0.41%	0.26%	0.32%
60	0.58%	0.36%	0.36%

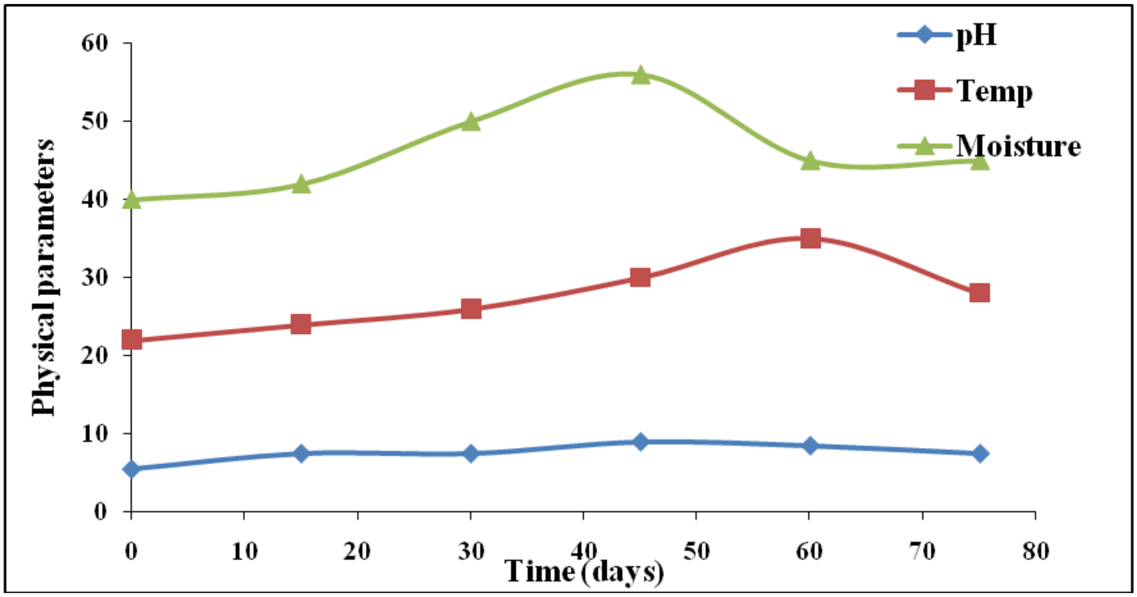

Figure 1 : Physical parameters of the Vermicomposting soil.

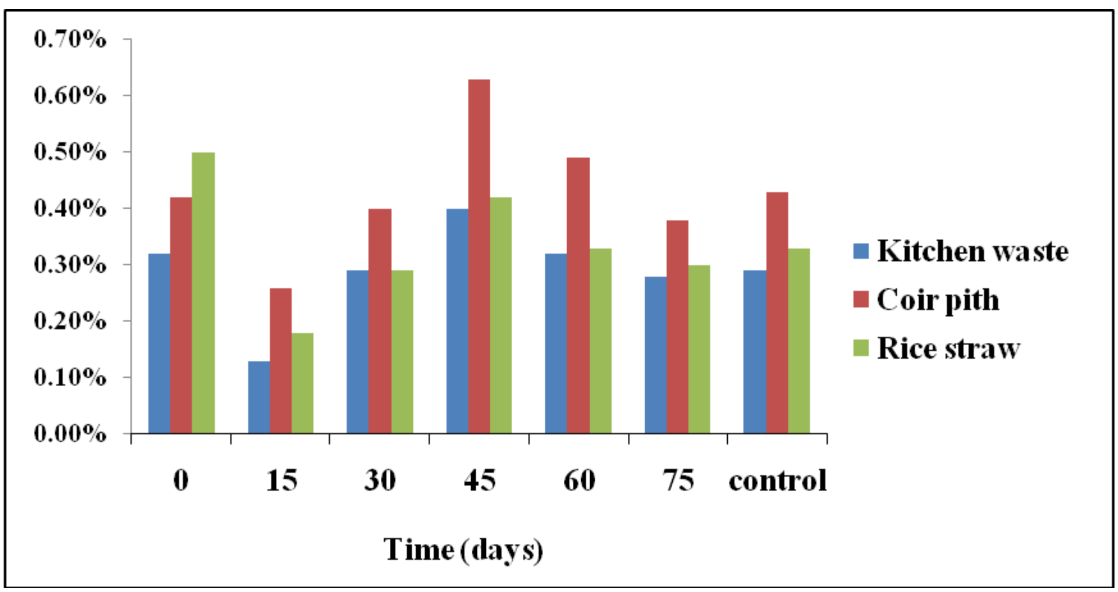

Figure 2 : Total Organic Carbon of Vermicompost substrates.

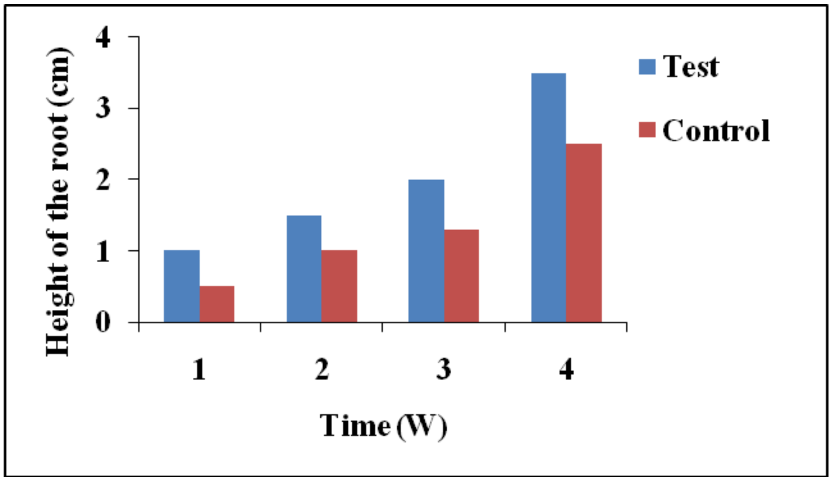

Figure 3 :Growth of the root of the plant *Vinca rosea* using kitchen waste Vermicompost

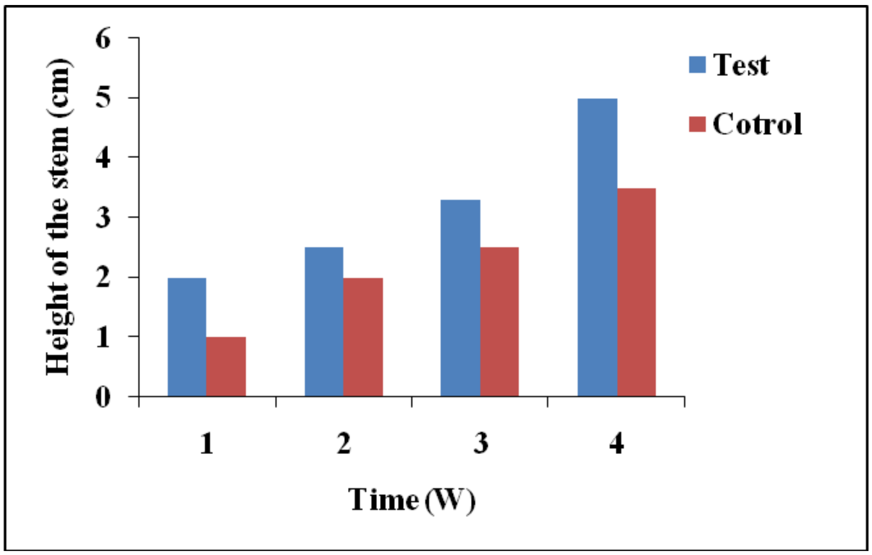

Figure 4 : Growth of the shoot of the plant *Vinca rosea* using kitchen waste

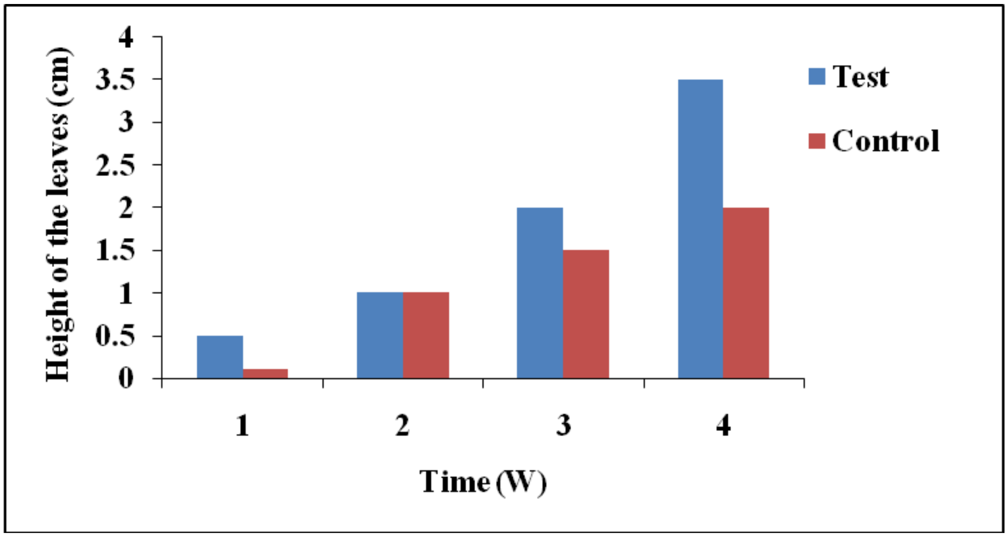

Figure 5 : Growth of the leaves of the plant *Vinca rosea* using kitchen waste as Vermicompost

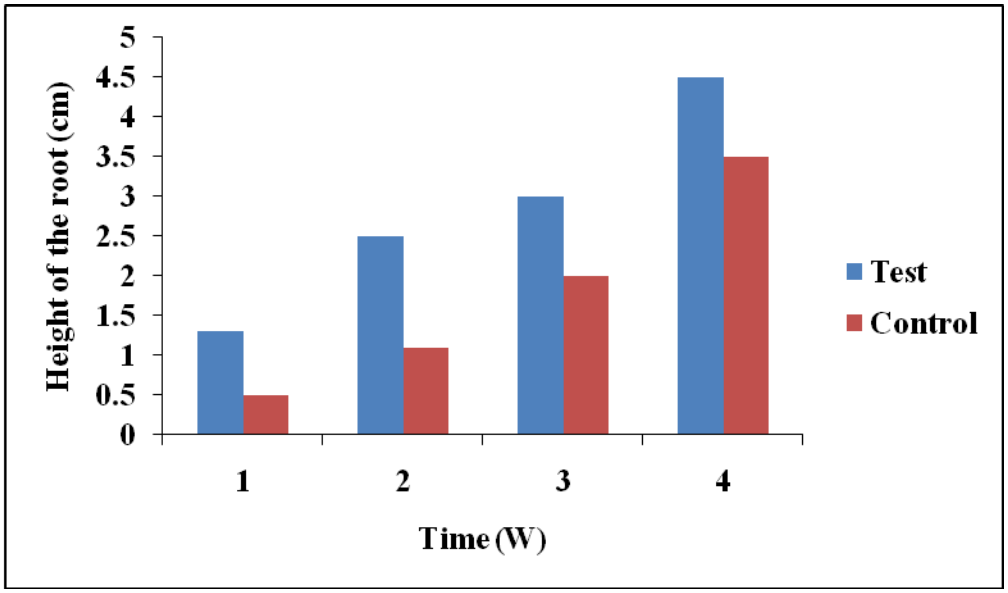

Figure 6 :Growth of root of the plant *Vinca rosea* using coir pith Vermicompost

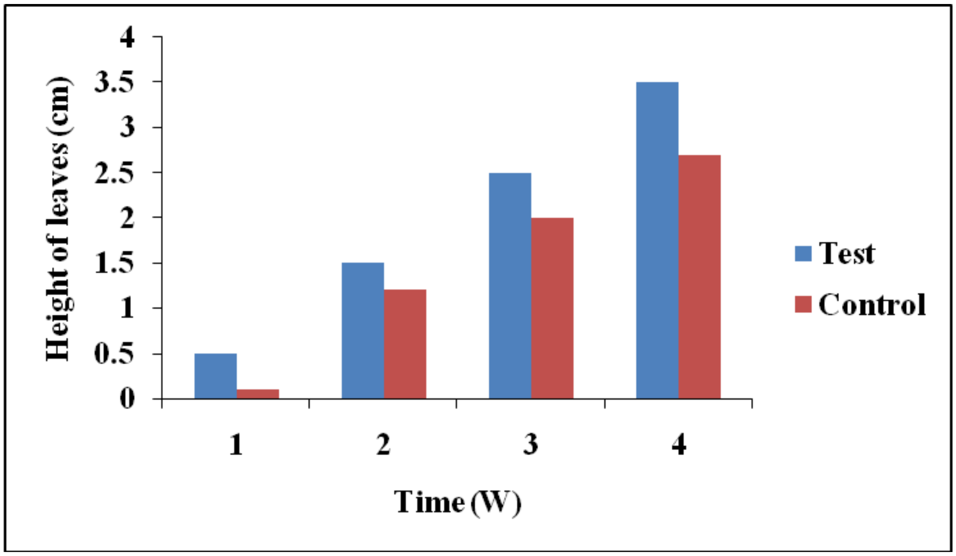

Figure 7 :Growth of the leaves of the plant *Vinca rosea* using coir pith Vermicompost

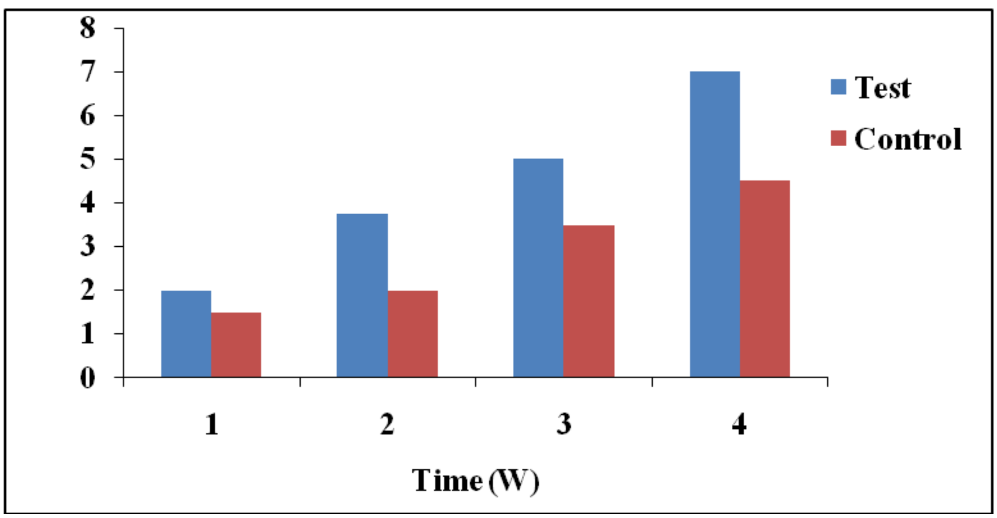

Figure 8 : Growth of the shoot of the plant *Vinca rosea* using coir pith Vermicompost

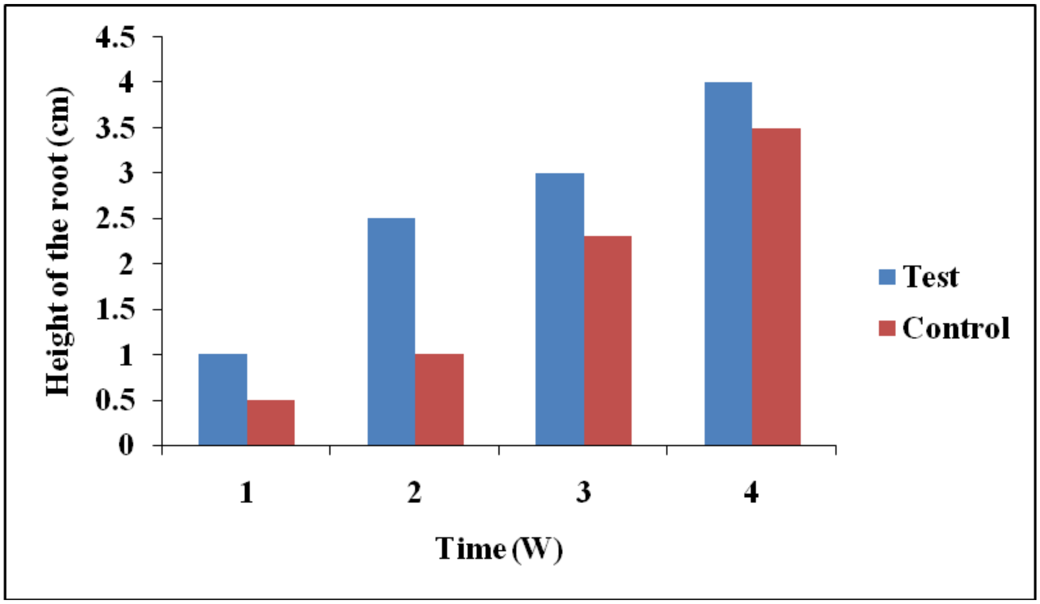

Figure 9 : Growth of the root of the plant *Vinca rosea* using rice straw Vermicompost

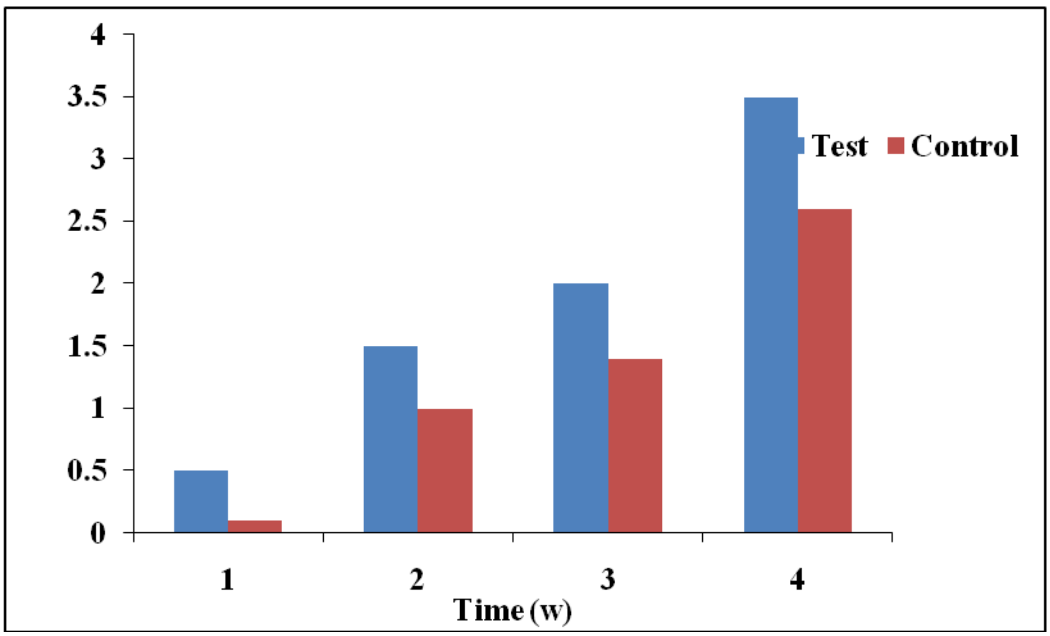

Figure 10 : The growth of plant *Vinca rosea* giving the length of the leaves using rice straw Vermicompost

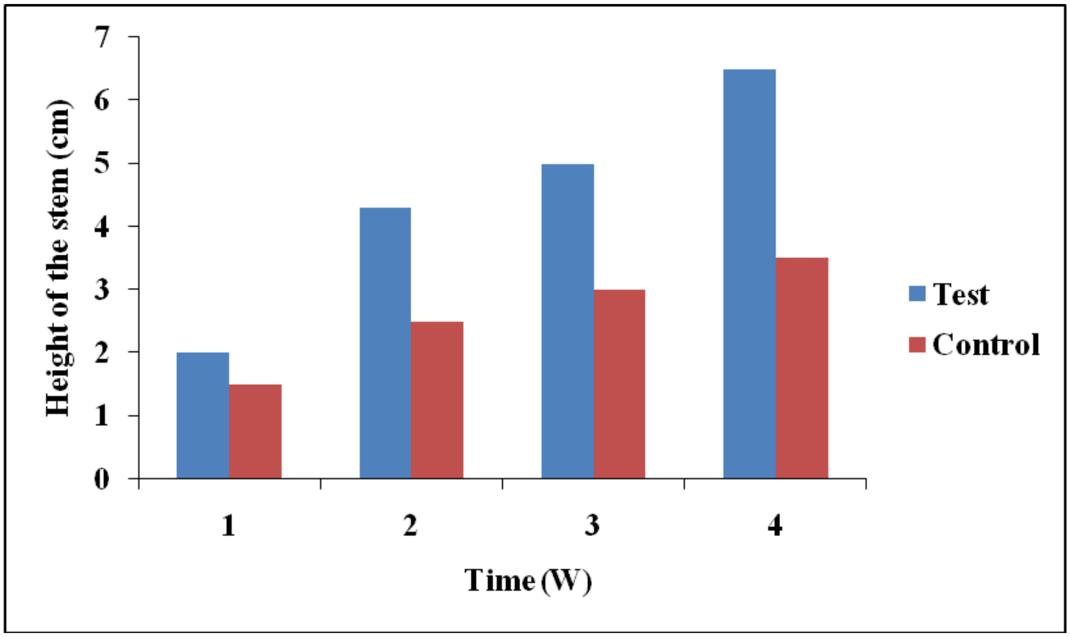

Figure 11: The growth of plant *Vinca rosea* giving the heigth of the shoot using rice straw Vermicompost.

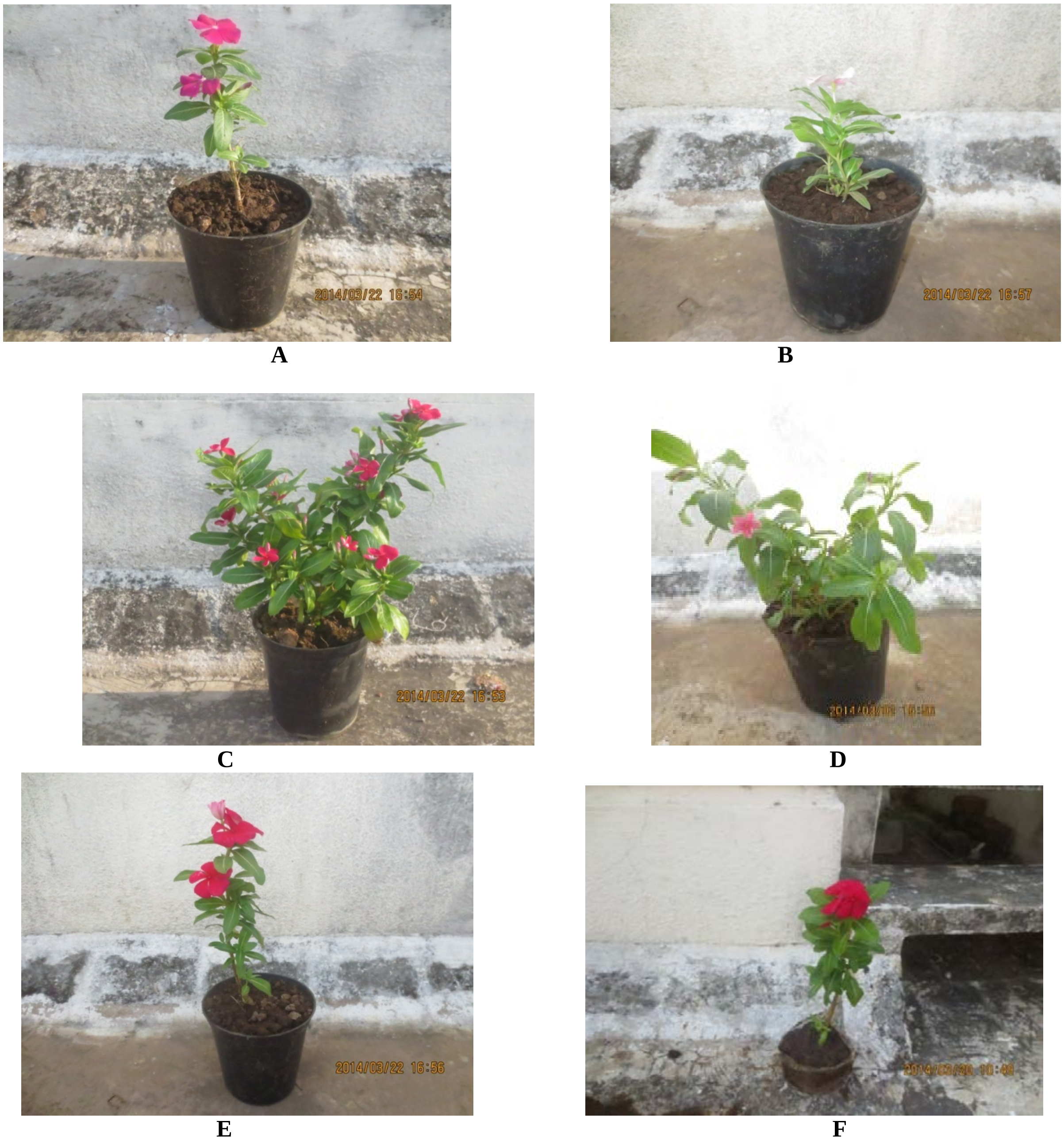

Figure 12: Growth of the plant *Vinca rosea* on different Vermicomposted substrates (A)- kitchen waste, (B)- control 1, (C)- coir pith, (D)- control 2, (E)- rice straw, (F)- control3

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