**VERMICONVERSION OF PAPER INDUSTRY WASTE FOR RECYCLING THE NUTRIENTS USIG EARTHWORM *Eudrilus eugeniae* kingberg ON GROWTH OF CLUSTER BEAN (C*ymopsis tetragonoloba*)**

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**ABSTRACT**

 Present study deals with the Vermiconversion of paper industry waste for recycling the nutrients using earthworm *Eudrilus eugeniae* kingberg on growth of cluster bean (C*ymopsis tetragonoloba*) The paper industry waste vermicompost was studied the physico chemical parameters like pH, temperature, electrical conductivity, organic carbon, total nitrogen, total phosphorous, total potassium and C:N (ratio) were studied. The enumeration microorganisms (Bacteria, Fungi and Actinomyces) of vermicompost. After preparation of vermicompost, vermiwash and vermicompost extract was prepared using after 45 days worked healthy earthworm. The Physico chemical parameters of vermiwash and vermicompost extract also studied. The growth parameters like seed germination, shoot length, root length, total fresh weight, total dry weight, leaf area index and vigour index were studied and biochemical characteristics such as chlorophyll a & b, total chlorophyll, carotenoide and anthocyanin were estimated. Based on the results growth parameters and biochemical characteristics were higher in Cluster bean treatments 5 and 6 using various concentration of vermicompost, vermiwash and vermicompost extract.

 **Keywords:** Vermicompost, Vermi wash, Vermicompost extract, Physico chemical parameters, Growth and Biochemical parameters.

**INTRODUCTION:**

 Presently many cities are facing the problem of disposal of solid waste generated within the cities. Solid waste arising out of domestic, commercial industrial and agriculture products comprises biodegradable (organic) and non-biodegradable material. Paper industry of India is the 15th largest industry in the world and contributes 5 million dollars to the government’s coffer annually. This will not only severely pollute land and ground water of that area but there will also be a waste of rich carbon resource (Nirmala Natarajan and Gajendran 2014).Disposal and environmental friendly management of these industrial wastes has become a serious global problem. Contamination of ground water, soils, as well as, food resources are some of the problems which have resulted from land filling practices of dumped waste materials.

 The safe treatment and recycling of solid pulp and paper mill sludge (SPPMS) emerging out of effluent treatment plants mixed with cow dung (CD) and food processing waste (FPW) to produce good quality compost using vermitechnology (Nogales *et al.,* 2005). The use of earthworms in the degradation of various types of wastes is continuing from the past so many years. These wastes include industrial, agricultural and domestic wastes etc. This study examines the potential of the African night crawler *Eudrilus eugeniae* in the vermicomposting of waste paper (Muddasir Basheer and Agrawal 2013). Vermicompost is rich in NKP (nitrogen 2-3%, potassium 1.85- 2.25% and phosphorus 1.55-2.25%), micronutrients, and beneficial Soil microbes and also contain ‘plant growth hormones & enzymes’. It is scientifically proving as ‘miracle growth promoter & also plant protector’ from pests and diseases. (Gajalakshmi *et al*., 2002)**.** The work related to the preparation of predecompost with vermicompost, preparation of vermiwash and vermicompost extract, physico chemical parameters, growth parameters and biochemical characteristics of cluster bean is total wanting. Hence the present study was carried out.

 **MATERIALS AND METHODS:**

 The paper waste sample was washed with water for two times. For the first wash, one kilogram of paper waste was washed with two liters of water and for the second wash, one liter of water was used and the paper waste was shade dried for a day, for preparing the predecompost the paper industry waste was directly mixed with cow dung in 1:3 (1 kg of sample and 3 kg of cow dung) ratio on dry weight basis in tank 40 cm height × 50 cm diameter size. Bacillus species [100 ml] was inoculated to the predecompost tank. The predecomposition tank set up was kept in 30 days. Water was regularly sprinkled and the substrate was regularly turned for 30 days. For preparing the vermicompost, the predecomposition was directly mixed with cow dung in 1:2 (1 kg of predecompost and 2 kg of cow dung) ratio on dry weight basis in same tank. The substrates were hold 60-80 percentage of moisture content and kept for 24 hrs stabilization. Seventy number of healthy, clitellate Earth worm *Eudrilus eugeniae* kingberg were introduced in the same tank. After 45th day, the trial tank compost were sieved and collected for paper industry waste vermicompost. The vermicompost extracts were analyzed for various physico chemical parameters such as pH, electric conductivity, total nitrogen, total phosphorous and total potassium using standard procedures (Mane and Raskar Smitha (2012).

 The enumeration of microorganisms such as bacteria, fungi and actinomycetes using standard plate count method (Karthika Arumugam *et al.,* 2013). The vermiwash and vermicompost extract were prepared using standard procedures (Seetha Devi *et al.,* 2012). The vermiwash and vermicompost extract were analyzed for various physico chemical parameter such as pH, electrical conductivity, total nitrogen, total phosphorous and total potassium using standard procedures (Ankur Rajpal *et al.,* 2011). Pot culture study was carried out for growth parameters were observed and biochemical characteristics were analyzed for 30 days and 60days intervals of pot culture study of Cluster bean.

**RESULTS AND DISCUSSION :**

 The physico chemical parameters of vermicompost were given table 1. The pHof the vermicompost 8.2, the temperature was 34°C, the electrical conductivity was 0.2 , the organic carbon was 46, the total nitrogen was 0.36, the total phosphorous was 1.18, total potassium  was 2.65 and the total C:N (Ratio) of the vermicompost 1.27. Antony *et al., (*2015) reported the vermicompost of paper waste using *Eudrilus eugeniae*were the physico chemical parameters such as pH (7.7), Phosphorous (0.06), Potassium (0.39) and Moisture was (5%) (Muddasir Basheer and Agrawal 2013) also reported the vermicompost of paper waste using *Eudrilus eugeniae* were the physico chemical parameter pH(7.6.).

 The enumeration of micro organisms (Bacteria, Fungi, and Actinomycetes) from 45 days worked vermicompost using *Eudrilus eugeniae*. The organisms  such as Bacteria was (85 × 106 ) Fungi (15 × 103) and Actinomycetes (148 × 104 ). Karthika Arumugam *et al., (*2013) studied the enumeration of micro organisms vermicomposting using after 45 days worked was such as Bacteria, Fungi, and Actinomycetes were analyzed. The physico chemical parameters of vermiwash such as pH was (7.48), Electrical conductivity (1.2), Temperature (29°C), Nitrogen  (1.65), Phosphorous (1.15), Potassium (2.21),  carbon (46) and C:N (ratio) was (0.03). Jayanthi and Jayanthi (2014) Reported the physico chemical parmeters of vermiwash such as Nitrogen (1.94), Phosphorous (3.40) and Potassium (0.96) were analysed. Tangavel *et al.,* (2003) also reported the organic waste vermicompost using *Eudrilus eugeniae* vermiwash physic chemical parameters such as pH, Nitrogen, and phosphorous were analyzed.

 The growth parameters of Cluster bean, germination efficiency was higher in T6 (97%) Lower in T0 (control)(53%). The shoot length was higher in T6 (10.2) lower in T0 (control) (13.8). Root length was higher in T6 (9.4) lower in T0 (control) (4.9). Total fresh weight was higher in T6 (1.9) lower in T0 (control) (0.3). Total dry weight was higher in T6 (1.6) lower in T0 (control) (0.1). Leaf area index was higher in T6 (3.9) lower in T0 (control) (0.1). Vigour index of Cluster bean was higher in T6 (6989) lower in T0 (control) (3289). Allah Bakhsh Gulshan *et al.,* (2013) Reported the growth parameters of okra plant using Root length (38.6) and Shoot length was (24.8) using various concentration of vermicomposting compared to inorganic fertilizer. Balbhim *et al.,*(2015) also reported the growth parameters of Cluster bean (*Cyamopsis tetragonoloba*) using fresh weight (2.6), and dry weight (0.44) was using various concentration of vermicomposting compared to inorganic fertilizer.

 The bio chemical characteristics of cluster bean chlorophyll a content was higher inT6 (1.9) lower in T0 (control) (0.4). Chlorophyll b content was higher in T6 (1.9) lower in T0 ( control) (0.3). Total chlorophyll content was higher in T6 (2.7) lower in T0 (control) (1.4 ± 0.9). Carotenoides content was higher in T6 (25.7) lower in T0 (control) (7.7). Anthocyanin content was higher in T6 (0.2) lower in T0 (control) (0.9). Mohamad Oma Albasha *et al.,* (2015) reported the biochemical characteristics of chlorophyll a, chlorophyll b and total chlorophyll were estimated the brinjal plant. Kamal Lochan Barmer *et al*., (2013) also reported the biochemical parameters of using Chlorophyll a (1.2), Chlorophyll b (1.9), Carotenoids (11), Anthocynanine (2.7). Sivakumar and Rajan (2014) Reported the bio chemical parameters of cluster bean such as chlorophyll a, chlorophyll b, total chlorophyll carotenoids and anthocyanin.

**CONCLUSIONS:**

 The present study was concluded that the earthworm *Eudrilus eugeniae* kingberg is more efficient in bioconversion of paper industry wastes vermicompost, vermiwash and vermicompost extract were using various concentration of pot culture study of Brinjal (60 days) was higher in growth parameters and it is acts as an excellent base for the establishment and multiplication of beneficial and symbiotic microbes. It being a natural means of soil fertility management strategy for sustainable agriculture.

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**Table 1. The physico chemical parameters of paper industry waste                 vermicompost**

|  |  |  |
| --- | --- | --- |
| **SNO** | **Parameters** | **At 45 days** |
| 1. | pH | 8.2 |
| 2. | Temperature | 34ºC |
| 3. | Electrical conductivity | 0.2 |
| 4. | Nitrogen | 0.36 |
| 5. | Phosphorous | 1.18 |
| 6. | Potassium | 2.65 |
| 7. | Carbon | 46 |
| 8. | C:N (ratio) | 1.27 |

**Table 2. Enumeration of microbial populations of vermicomposts**

|  |  |  |  |
| --- | --- | --- | --- |
| **S.NO** | **Microorganisms** | **No of Colony forming****units (CFU) of Commercial vermicompost** | **No of Colony forming units (CFU) paper industry waste vermicompost** |
| 1. | Bacteria | 59.5x106 | 85x106 |
| 2. | Fungi | 9x103 | 15x103 |
| 3. | Actinomyces | 102.5x104 | 148x104 |

**Table 3. Physico chemical parameters of paper industry waste vermiwash  and vermicompost extract**

|  |  |  |  |
| --- | --- | --- | --- |
| **S.NO** | **Parameters** | **Vermiwash** | **Vermicompost extract** |
| 1. | pH | 7.48 | 6.8 |
| 2. | Electrical conductivity | 1.2 | 0.5 |
| 3. | Temperature | 29ºC | 30ºC |
| 4. | Nitrogen | 1.65 | 2.38 |
| 5. | Phosphorous | 1.15 | 1.95 |
| 6. | Potassium | 2.21 | 2.19 |
| 7. | Carbon (%) | 46 | 53.73 |
|  8. | C:N (ratio) | 0.03 | 0.04 |

**Table 4. The growth parameters of Cluster bean for 60 days pot culture study**

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Growth parameters** | **T0** | **T1** | **T2** | **T3** | **T4** | **T5** | **T6** |
| Germination efficiency | 53 | 77 | 80 | 70 | 70 | 93 | 97 |
| Shoot length | 13.8±6.1 | 14.3±6.4 | 15.1±6.8 | 17.1±7.6 | 20.1±8.9 | **22.4±11.6** | 24.7±12.4 |
| Root length | 4.9±1.8 | 5.4±2.8 | 6.1±3.2 | 7.9±4.6 | 8.1±5.6 | 9.4±6.6 | **10.2±7.2** |
| Total fresh weight | 3.1±0.2 | 4.1±0.1 | 5.2±0.2 | 6.1±0.3 | 6.4±0.2 | **6.6±0.4** | 6.2±0.2 |
| Total dry weight | 1.5±0.2 | 2.6±0.1 | 2.8±0.1 | 3.9±0.1 | 3.1±0.1 | **3.5±0.1** | 3.3±0.1 |
| Vigour index | 3289 | 4325 | 4220 | 5428 | 5392 | 6863 | **6689** |

**Table 5. The biochemical characteristics of Cluster bean for 60 days pot culture study**

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Biochemical characteristics** | **T0** | **T1** | **T2** | **T3** | **T4** | **T5** | **T6** |
| Chlorophyll (a) | 0.4±0.1 | 1.1±0.2 | 1.2±0.1 | 1.4±0.1 | 1.6±0.2 | 1.7±0.2 | **1.9±0.3** |
| Chlorophyll (b) | 0.3±0.1 | 0.4±0.2 | 0.2±0.5 | 0.4±0.3 | 1.6±0.2 | 1.6±0.1 | **1.9±0.2** |
| Total Chlorophyll | 1.4±0.3 | 1.6±0.4 | 1.9±1.4 | 2.1±0.2 | 2.3±0.5 | 2.6±0.5 | **2.9±0.1** |
| Carotenoide | 7.7±2.2 | 10.8±3.2 | 13.5±4.1 | 16.1±5.0 | 19.0±6.0 | 22.7±7.2 | **25.7±8.4** |
| Anthocyanin | 0.21 | 0.13 | 0.22 | 0.21 | 0.16 | 0.11 | **0.91** |