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Vermicomposting of biogas plant slurry and cow dung with *Eudrilus eugeniae* and its effects on *Vigna radiata*

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ABSTRACT

Vermicomposting is a biological process for the management of solid wastes and animal excreta. The present study was undertaken to produce vermicompost from biogas plant slurry (BPS) mixing with cow dung using Eudrilus eugeniae. The quality of prepared compost was compared with control and its yield potential was evaluated in the field experiments of Vigna radiata. The results revealed that germination of seeds, root length, shoot length, number of root hairs, numbers of leaves were well enhanced with the application of compost from biogas plant slurry and cow dung mixture. It is concluded that the vermicompost from BPS and Cow dung mixture was superior in promoting the plant growth.

Key words: Biological conversion; cattle dung; *Eudrilus eugeniae*; seed germination; NPK

INTRODUCTION

More traditionally and conventionally in India agriculturalists produced manures in their fields with the help of earthworms [1]. It plays an important role in the breakdown of organic debris on soil surface and soil turnover process [2]. Later this process was established as a vermi-technology in the year of 1970 in Ontario, Canada [3]. In the present decade in India people are getting familiarized with this technology because of its superior quality [4]. One of the most important environmental problems facing in India is solid wastes generation due to urbanization and there is no adequate disposal method of solid wastes [5]. The total quantity of municipal solid wastes generation has been reported as 500 tonnes/day and the average generation rate has been estimated as 0.39 kg/capita/day [6].

In the past few decades, the Government of India promoted biogas production using cattle dung and other organic wastes at individual and community levels. Slurry remaining from the biogas plant is a good quality of manure used as a soil conditioner in agricultural fields [7]. Though, it is of a good quality it makes some negative impacts on seed germination and plant growth. The presence of ammonia in the slurry posed a threat by either killing the seeds or inhibiting their germination; even if the seeds grew, the excessive supply of slurry stopped the flowering [8]. As the earthworms act as bio filter, they may be used to improve the crop production and pollution free management of cattle dung and biogas plant slurry [7]. Literature survey has revealed that vermicomposting technology can be efficient for the management of cow dung and Biogas plant slurry. In addition, it increases the productivity of crops and reduces the needs of inorganic fertilizers [1]. Hence, this study was undertaken to produce vermicompost by using of biogas plant slurry and cow dung and its efficacy in plant growth.

MATERIALS AND METHODS

The vermicomposting units were maintained at Arboretum in an open shadow of Bishop Heber College, Tiruchirappalli. The process was segmented as follows,

Experiment 1: (Preparation of vermibed)
Two different types of vermibed were prepared for vermicomposting, in the ratio of 3:1(Red soil and Cow dung) and 1:2:1 (Red soil, biogas plant slurry and Cow dung). They were labeled as "Control" and "Treated" respectively. The moisture content and the temperature were maintained by routine sprinkling of water. After 2 weeks of pre composting, 250 individuals of matured *E. eugeniae* species were introduced in to the each vermibeds. At the end of 60^{th} day the physico-chemical parameters of the vermicompost was determined in the laboratory following standard methods [9].

Experiment 2: (Seed germination and plant growth)
The field crop *Vigna radiata* was selected for evaluating the plant growth in the vermicompost. Two sets of plastic containers(each having 45-cm diameter and 25-cm depth), were chosen. In each set, there were five containers. In the first set, the soil was applied with vermicompost prepared from "Control" and in the second set; the soil was applied with vermicompost prepared from "Treated". In each container 75 healthy seeds were sown.

RESULTS AND DISCUSSION

The physico-chemical characteristics of the "Control and Treated" vermicompost are presented in figure 1-3. Seed germination, plant growth rate and Earthworm multiplication are presented in figures 4, 5 and 6 respectively.

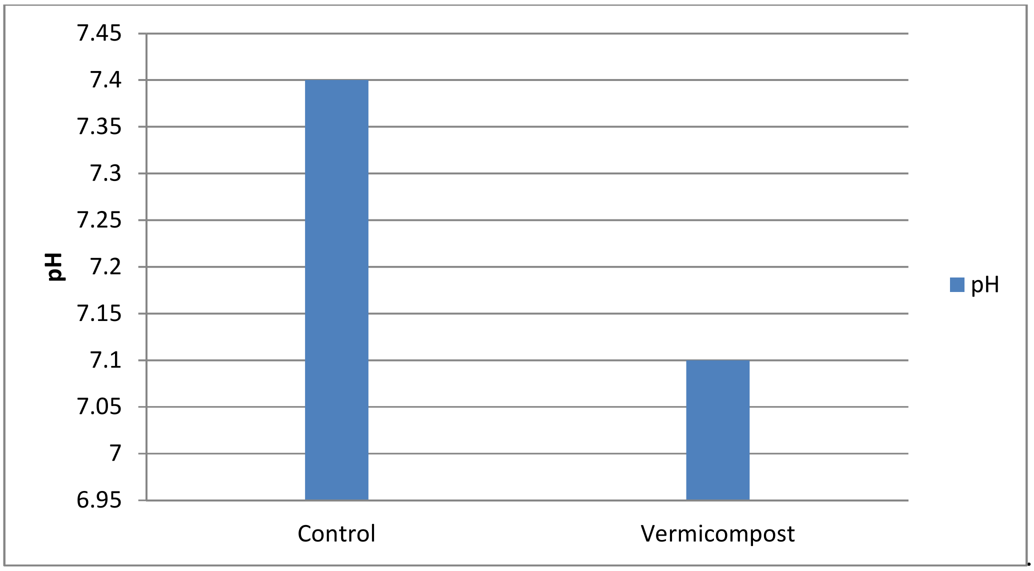

Figure 1: pH of vermicompost

The pH decreased in treated when compared to control. The overall decrease of pH may be due to involvement of microorganisms in the decomposition during vermicomposting [10]. Production of CO_2, and organic acids by microbial decomposition during vermicomposting was the inherent factor for the pH decrement [11], [12]. A significant increase EC in 'Treated' was due to the breaking down of organic compounds into inorganic substances by earthworms through ingestion and then defecation [13]. The total organic carbon has significantly decreased in treated when compared with control. A decrease in organic carbon is an indicator of enhanced decomposition [14], [15], [16]. The significant percentage change indicated that earthworms accelerated the decomposition of the organic matter. [17], [18].

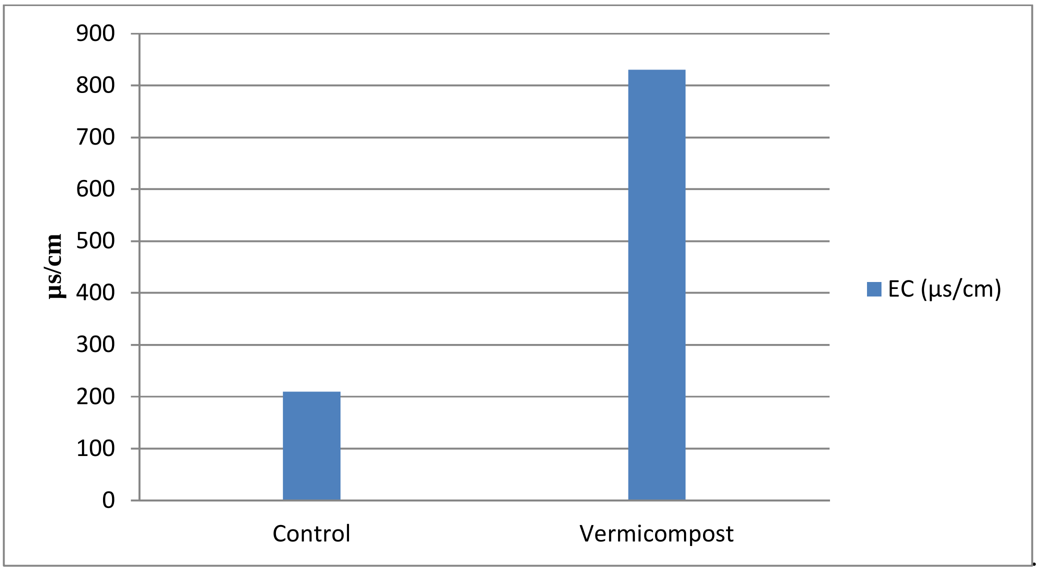

Figure 2: EC of vermicompost

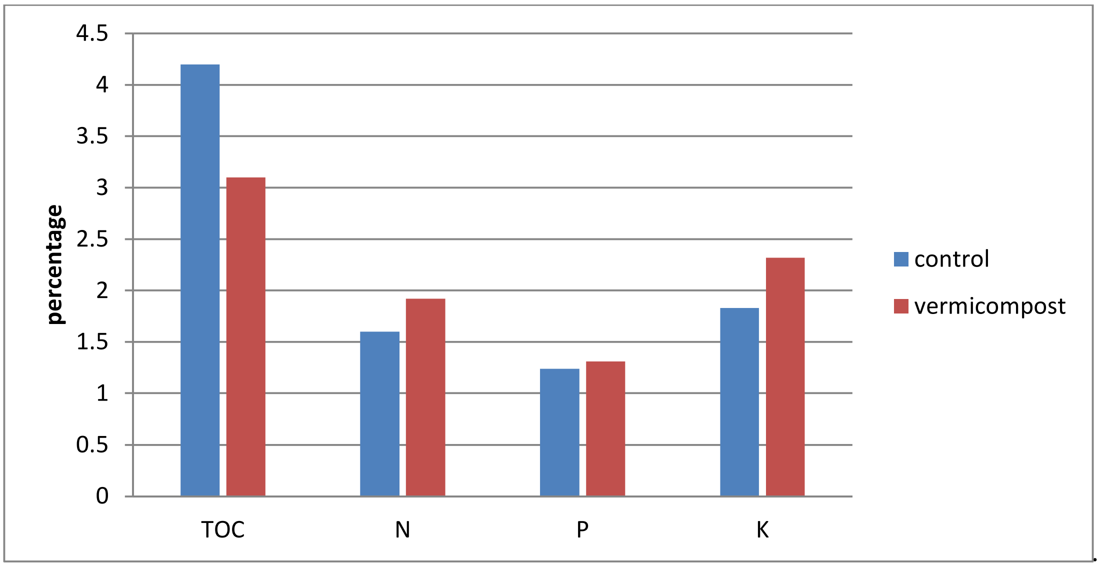

Figure 3: Nutrient levels of vermicompost

From the results, it was clear that there was a significant increase in the NPK values of the treated when compared with control. The nitrogen level increased due to the fact that earthworms enhanced the nitrogen cycle which attributed to the increased levels of nitrogen in vermicompost. The losses of organic carbon might be responsible for nitrogen addition in the form of mucus, nitrogenous excretory substances, growth accelerate hormones and enzymes from the gut of earthworms [19]. Similarly, the increased phosphorus level was due to mineralization of phosphorous. The release of phosphorous in the available form is performed partly by earthworm gut phosphatases and further release of phosphorous might be assigned to the phosphorous-solubilizing microbes present in vermicast [10]. Increase of potassium in 'Treated' was higher than 'Control' (1.83%; 2.32%). The increase of potassium in treated might be due to changes in the distribution of potassium between exchangeable and non-exchangeable forms. The earthworm processed waste material contains high concentration of exchangeable potassium, due to enhanced microbial activity during the vermicomposting process, which accordingly enhanced the rate of mineralization [20].

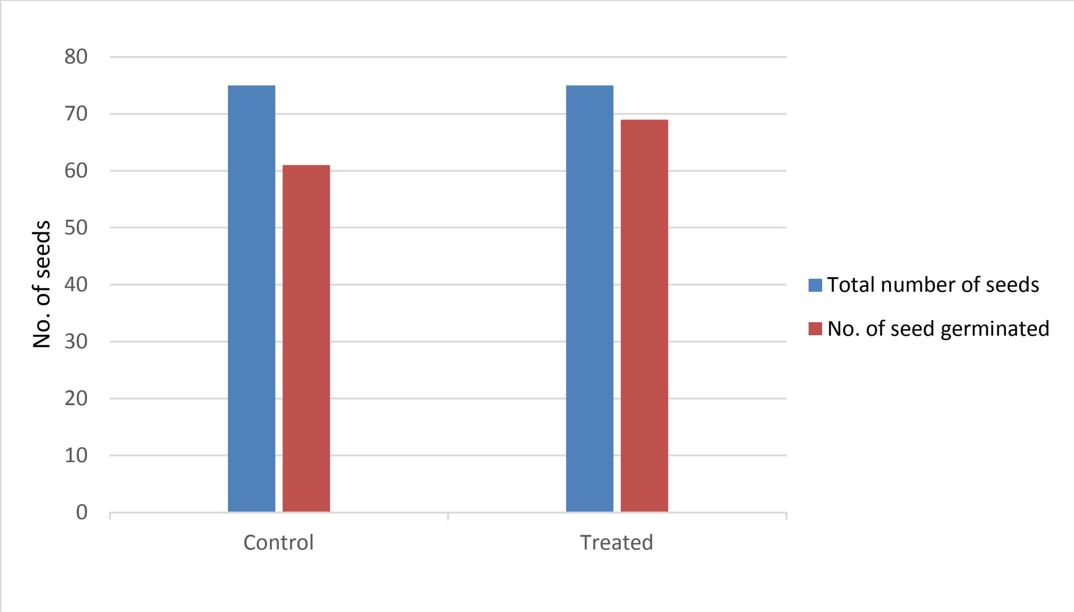

Figure 4: Seed germination of *Vigna radiata*

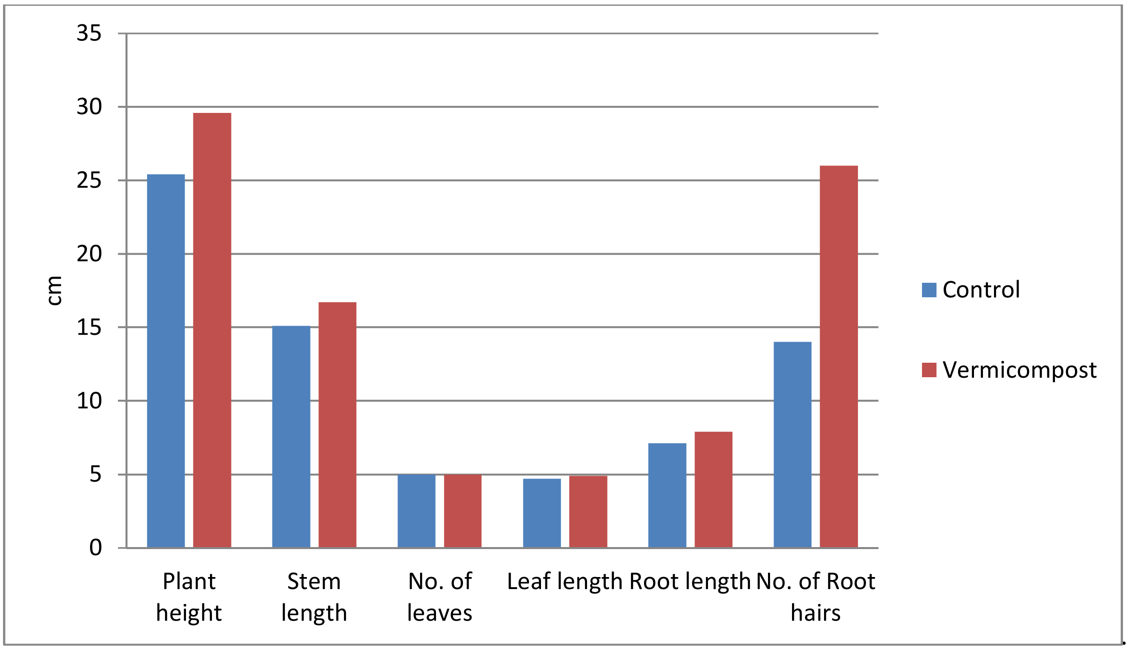

Figure 5: Plant growth rate during vermicompost

Effects of Vermicompost on Growth of *Vigna radiata*

The maximum plant growth in terms of shoot length, root length, root hairs, leaf length and number of leaves were observed in the treated compost on 20th day when compared with control. The treated contains more macro and micro plant nutrients. So, the plant could easily assimilate them for the growth and development. This may due to some of the secretions of worms and its associated microbes, which act as growth promoters along with other nutrients [21].

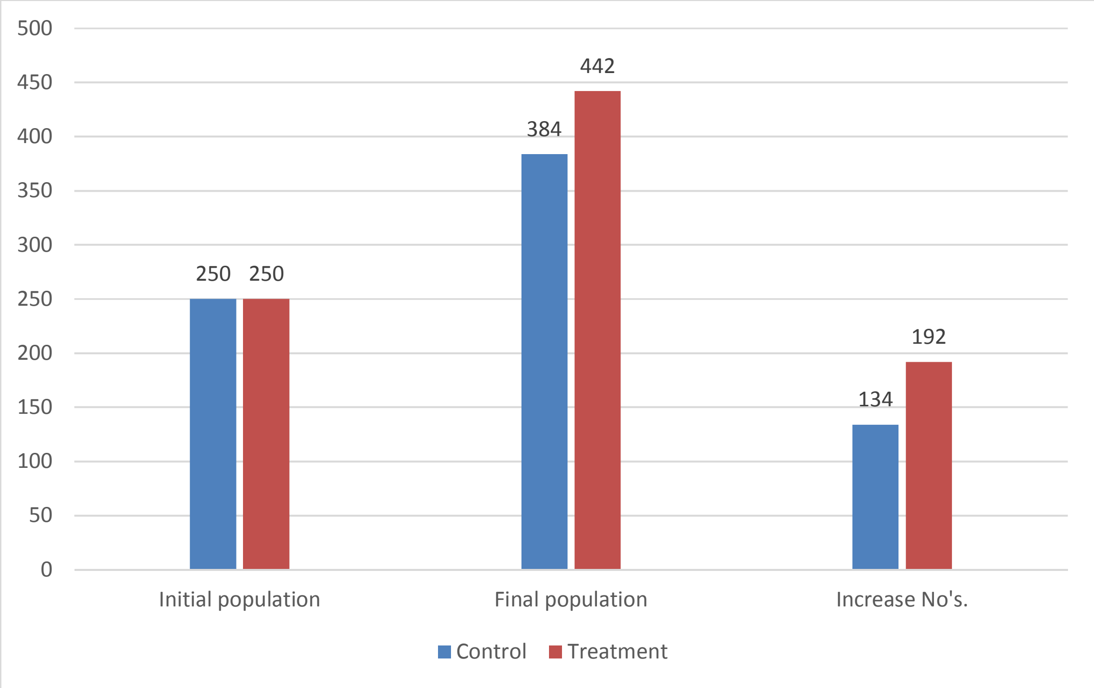

Figure 6: Earthworm multiplication during vermicompost

Earthworm multiplication

Earthworms increased to 384 and 442 in control and treated respectively. It concludes that biogas plant slurry and cow dung mixtures enhance the earthworm multiplication.

CONCLUSION

The present investigation indicates that biogas plant slurry and cow dung can be used as a raw material in vermicomposting process. It is concluded that, biogas plant slurry contribute to increase in NPK values.

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