INTRODUCTION

Though we have vast cultivable land and enough water in this planet, still we are unable to fulfill the basic needs of the people. It is estimated that one billion people in the world suffer from hunger and malnutrition in their day to day life. It is roughly estimated that about 24,000 people die every day from hunger or hunger-related causes. This is down from 35,000 ten years ago, and 41,000 twenty years ago. Three-fourths of the deaths in the world population are those of children under the age of five. Famine and wars cause about only 10 percent of hunger deaths, although they tend to be the ones one hears about most often. The majority of hunger deaths are caused by chronic malnutrition only. Families facing extreme poverty are simply unable to get enough food to eat at least one time a day (www.biofertilizer.com).
In order to increase the crop production for fulfilling the nutritional requirements of the day-by-day increasing population, the system relies exclusively on the use of chemical fertilizers. It is also proved that use of chemical fertilizers and other pesticides has caused tremendous harm to the air, water and soil and the common men are suffering in many ways because of it. Therefore, increase in population, environmental pollution, contamination in water and soil are the major concerns in today’s world and there is a reason to search for alternative methods of increasing plant production in an eco-friendly manner, adequate management of natural, renewable resources and the reduction of chemical inputs. There is no doubt that all chemical fertilizers support plant growth and development, which results in higher production, and hence are beneficial if used judiciously, but it is also very true that bio-fertilizers are totally safe and also increase the production.

Soil is a physical entity that is inhabited by millions of organisms which play an important role in the modification of the soil ecosystem. Among the soil organisms, earthworms form one of the wiggling wonders that perform a biocatalytic function in soil metabolism. The earthworms belong to the Phylum Annelida, Class Chaetopoda and Order Oligochaeta. Of more than 4,200 species of known oligochaetes in the world, about 3,200 are Megadrili (earthworms) (Julka, 1993).
The whole world depends only on farmers for daily food. About 70 percent of the economy depends on agriculture only. Farmers regard earthworms as their friends and hold them in the high esteem as nature’s ploughman (Darwin, 1881). It is a well proved fact that earthworms influence soil structure, decompose organic materials and recycle nutrients present in the soil through physical participation by feeding, fragmentation, aeration, turnover and dispersion; through chemical participation by digesting the organic substrates and by contributing nutrients to the soil through their metabolic by-products and dead tissues; and, through biological participation by providing shelter to the beneficial microbes in their gut and by activating soil microbial activity through the excretion of castings (Senapati and Dash, 1984; Lee and Foster, 1991; Blair et al., 1995, Daniel and Karmegam, 2000; Mahalingam and Daniel, 2008).

Pollution by organic materials in the environment is becoming an ever-increasing problem to mankind due to the growth of human population, industries and their needs. On the other hand, the extensive use of chemical fertilizers has led to the depletion of soil fertility, leading to loss of crop productivity in addition to environmental pollution. These two problems can very well be solved by utilizing earthworms.
Nowadays earthworms are increasingly utilized for decomposing and recycling organic materials worldwide and the process is known as vermicomposting (Edwards and Bohlen, 1996). The compost thus derived is rich in available nutrients, soil beneficial microbes and plant growth promoting substances (Krishnamoorthy and Vajranabhaiah, 1986; Tomati et al. 1988; Bhiday, 1994; Edwards and Bohlen, 1996, Daniel and Karmegam., 2000). Promotion of vermiculture technology for the production of vermicompost will provide a vast scope for improving soil health and crop yield and also create employment opportunities.

Although we have great variability in habitat conditions and occurrence of large number of earthworm species with a variety of biological traits but with few detailed studies, it might not be possible to develop a really predictable model and so there is a need for an in-depth study of different earthworm populations and communities. Population biology provides the first basic information about any species and is regulated by both abiotic and biotic factors (Senapati and Sahu, 1993). The biology and ecology of some of the Indian earthworms are available in certain croplands, grasslands, pastures, deciduous forests; sacred groves and foothills (Krishnamoorthy and Vajranabhaiah, 1986; Bhadauria and Ramakrishnan, 1989; Ganihar, 1996; Chaudhuri and
Bhattacharjee, 1999; Karmegam and Daniel, 2000-a and 2000-b). However, there are many areas of earthworm biology and ecology which have not been studied sufficiently. This is particularly true of Tamil Nadu, where only fragmentary reports are available (Jamieson, 1977; Ismail and Murthy, 1985; Ismail et al. 1990; Karmegam and Daniel, 2000-a, 2000-b and 2001).

The value of vermicomposting was fully recognized only in the 20th century. At Hollands Landing, Ontario, Canada, the first pioneering vermicomposting of waste was attempted in 1970 and later, a series of conferences organized by scientists in different parts of the world, notably by Tomati et al. (1983) in Rome, Italy, Harteinstein (1978) in Syracuse, New York, USA, Appelhof (1981) in Kalamasoo, Michigan, USA, and Dash et al. (1984) in Orissa, India, popularized the technology worldwide. Besides, sessions on earthworms and waste management were regularly included in the International Symposium on Earthworm Ecology (Satchell, 1967, Bonvicini-Pagliai and Omodeo, 1987; Hoerschelmann and Andres 1994; Edwards, 1997 and 1998). Inspite of the availability of a large body of scientific literature on vermiculture and vermicomposting in developed countries, little scientific work has been undertaken in developing countries, where there is evidence of a huge
potential for using earthworms to process organic wastes (Aranda et al., 1999; Manivannan and Daniel., 2008).

Vermicompost is a humus-like end-product obtained by the action of earthworms on organic materials. The earthworm composts (vermicompost) can be produced from almost all types of organic wastes after suitable processing under controlled processing conditions. Vermicompost can also be used as a structural additive for poor soils. An important feature is that, during the processing of the wastes by earthworms, many of the nutrients that they contain are changed to forms which are more readily taken up by the plants, such as nitrate, ammonium, nitrogen, exchangeable phosphorus, soluble potassium, calcium and magnesium (Edwards and Bohlen, 1996). So vermicompost is rich in available nutrients required for plant growth (Karmegam and Daniel, 2000-a). It also contains free amino acids and plant promoting substances such as gibberellins, cytokinins and auxins (Krishnamoorthy and Vajranabhaiah, 1986; Tomati et al. 1988; Haimi et al. 1992; Bhiday., 1994).

Laboratory level as well as field level application of vermicompost showed higher growth rate of plants, increased uptake of nutrients and increased rate of yield in crops like paddy, tomato, green
gram and cow pea (Kale and Bano, 1986; Tomati and Galli, 1995; Ramaliingam, 1997; Karmegam et al. 1999; Karmegam and Daniel, 2000). The application of vermicompost not only influences plant growth but also the growth of beneficial microorganisms in the soil (Kale et al. 1992; Bhagyaraj and Sreeramulu, 1993, Nagarathanam et al., 2000).

The inoculation of beneficial microorganisms into the soil, which improves plant growth and productivity, is called biofertilizing. Research during the past few decades has led to the identification of certain biological organisms and their products that could potentially be used as fertilizer sources. This strategy of fertilizing the soil with biological sources has been widely accepted and recognized as a viable alternative to the application of chemical fertilizers. Among the different groups of plants, some are used as effective fertilizer sources for enriching the soil with carbon, nitrogen, phosphorous and other minerals. Nitrogen is one of the basic requirements for the growth, productivity and yield of plants.

Most of the leguminous plants obtain their nitrogen through symbiotic nitrogen fixation by the bacterium Rhizobium sp. found in root nodules. Because of this characteristic, many leguminous plants have been used as nitrogen source in traditional agricultural practices such as
crop rotation and green manuring. Symbiotic nitrogen fixation in the legume- *Rhizobium* symbiosis is of considerable agricultural importance, as it leads to a significant increase in the combined nitrogen content of the soil (Dadarwal and Yadav, 1989).

Awareness about practicing cultivation using biofertilizer has been created among farmers by practical demonstrations by the government and also by the non-governmental organizations (NGOs). The concept of sustainable agriculture has been recently developed and it involves the successful management of resources to satisfy the changing human needs for maintaining and for enhancing the quality of the environment and for conserving resources (Thampan, 1995; Bhatnagar and Palta, 1996). Thorough knowledge about beneficial microbes has now been obtained with the help of depth research and advancement of technology. We come to know that it also helps for high production of crops. So we can inoculate the microbes along with vermicompost for increasing soil fertility and crop productivity.

Soluble fertilizer phosphorus (P) is the world’s second largest bulk agricultural chemical and, as such, is absolutely essential for food production. However, most soil phosphorus, approximately 95-99 percent, is present in the form of insoluble phosphates and hence cannot
be utilized by plants (Vassilev and Vassileva 2003). To increase the availability of phosphorous to plants, large amounts of fertilizers are used on a regular basis. But, after application, a large proportion of the fertilizer phosphorus is quickly transferred to the insoluble form (Omer, 1998). Therefore, a very little percentage of the applied phosphorous is used, making continuous application necessary. It has been reported that many soil fungi and bacteria can solubilize inorganic phosphates (Asea et al. 1988; Singal et al. 1994, Paul and Daniel., 2007).

Phosphorus is mineralized from organic sources. The sources of phosphates are an important factor in determining overall phosphate availability in soil and resulting in differential availability of phosphate to crop plants. The general level of phosphate in India can vary from less than 100 ppm to over 2000 ppm; average figures for agricultural soils vary from 200 to 800 ppm (Ghosh and Hasan, 1979). About 98 percent of Indian soils contain low to medium (insufficient) amount of available phosphates.

Phosphorus is involved in various chemical and biochemical reactions like root development, nodulation in legumes and metabolic activities, especially in synthesis of protein. Soil microorganisms play a significant role in mobilizing phosphate for plants by bringing about
changes in pH in rhizosphere soil and also by producing chelating substances, which leads to solubilization of phosphates (Haider et al. 1991). These microbes are known as phosphate solubilizers consisting predominately of fungal, bacterial and actinomycetes species collectively called phosphate solubilizing microorganisms (PSM) (Nautiyal et al., 2000). Secretion of organic acids and phosphates by microbes is the common method of facilitating the conversion of insoluble forms of phosphate to plant available forms (Kim et al., 1998; Mahalingam and Daniel., 2008). Microbiological activity in the rhizosphere could dissolve sparingly soluble inorganic phosphate and increase plant growth (Gerretsen, 1948).

Seed or soil inoculation with phosphate solubilizing bacteria (PSB) is known to improve solubilization of fixed soil P and applied phosphates, resulting in higher crop yield. Phosphate solubilizing microbes (PSM) could be effective as biofertilizers in enhancing crop yields in phosphate deficient soils (Subbarao, 1982; Goldstein, 1986; Kucey and Laggett, 1989). Biofertilizers most commonly refers to the use of soil microorganisms to increase the availability and uptake of mineral nutrients for plants.
Cowpea, *Vigna unguiculata* (L.) occupies a very important position as a relatively inexpensive, popular source of legume protein and a valuable food. This legume is used for both human consumption and as a concentrate feed for cattle. Its grains are rich in protein and digestible carbohydrate; its energy content is nearly equal to that of cereal grains. Being rich in protein (23.4 percent) and containing many other nutrients, it is also known as vegetable meat. Cowpea grain also contains 60.3 percent carbohydrates and 1.8 percent fat. Cowpea fixes atmospheric N and thus contributes to the available N levels in the soil. One of the more remarkable things about cowpea is that it thrives in dry environments. Cowpea, a drought tolerant crop, gives such a heavy vegetative growth and covers the ground so well that it checks the soil erosion and can later be ploughed in as a green manure. Biofertilizer enriched vermicompost can increase the crop yield, making use of natural soil resources.

Based on the necessity to improve and increase crop production in a healthy way the present study has been undertaken with the following objectives.
Objectives;

- To prepare vermicompost from leaf litter of selected plant species using the earthworm, *Eudrilus eugeniae*.
- To investigate the physico-chemical properties of worm-worked and worm-unworked vermibed substrates.
- To enumerate the total microbial population (bacteria, fungi and actinomycetes) present in the worm-worked and worm-unworked vermibed substrates.
- To isolate *Rhizobium* sp. from leguminous plant root nodules, to authenticate them by biochemical as well as molecular studies and mass multiplication,
- To isolate phosphate solubilizing microorganisms from rhizosphere soil and to identify them by morphological, biochemical and molecular studies and mass multiplication.
- To prepare vermicompost enriched with biofertilizers (rhizobium and phosphate solubilizing bacteria and fungi) and conduct pot culture studies using cowpea, *Vigna unguiculata* (L.) Walp.