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# Effect of Vermicompost on Root Numbers and Length of Sunflower Plant (*Helianthus annuus* L.)

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**In agricultural land soil fertility depletion is an important draw back due to continuous cultivation. Modern agricultural operation has modified the physical, chemical and biological activity of the soil. In order to increase the soil fertility, inorganic fertilizers are being widely utilized in our cultivable lands. Even though they promote the growth of crops, their toxic effect is the negative impact by means of their over utilization. To overcome all these unwanted factors the application of organic manure especially vermicompost is recommended. Vermicompost is a rich source of macronutrients, micronutrients, vitamins, plant enzymes and plant growth hormones. So, the present investigation was carried out to study the influence of vermicompost on the root numbers and length of the Sunflower plant (*Helianthus annuus* L.). Different percentages of vermicompost (25, 50, 75 and 100%) derived from the earthworm, *Eudrilus eugeniae* was made with red soil. The Sunflower plant, *Helianthus annuus* L. was cultivated in these vermicompost-red soil mixtures at 30, 60 and 90 days periods of exposures. At the end of each period of exposures the plants were sacrificed and the root numbers were counted and the root length was measured. The maximum root numbers and length were noticed in 75% vermicompost concentration at all periods of exposures.**

**Key words:** *Eudrilus eugeniae*, Vermicompost, Root numbers, Root length.

In agricultural land soil fertility depletion is an important drawback due to continuous cultivation. Modern agricultural operation in the name of green revolution rose to regain the soil fertility by introducing agrochemicals and pesticides. With the advent of green revolution technology in terms of enhancing crop production, the extensive use of synthetic agrochemicals such as inorganic fertilizers and pesticides with adoption of nutrient-responsive, high-yielding varieties of crops have been boosted to promote the plant growth as well as high production rate. The success of industrial agriculture and green revolution in recent decades has often marked significant externalities, affecting natural resources and human health as well as agriculture itself (Rao, 1999; Gupta, 2005; Ranganathan, 2006; Haris Babu *et al.,* 2006; Pandit *et al.,* 2008). Even though they promote the growth of crops, their toxic effect is negative impact by means of their over utilization. Although the chemical fertilizers have many nutrients and higher laboratory analysis

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percentages, the ability of the plant to optimally use these nutrients is limited, since the nutrients are not broken down in a manner that plant can readily use. Moreover, the chemical fertilizers do not have sufficient organic matter that is essential for plant growth.

Chemical fertilizers are most often detrimental to physical, chemical and biological activities of soil. It is also known to be harmful to the macro invertebrate, the earthworm. Vermicompost improves soil aeration because they do not pack together when mixed in soil. Earthworm castings improve the soil drainage, reducing waterlogged soil and root rot. The soil water retention capacity also improves because vermicompost contains absorbent organic matter that holds only the necessary amounts of water needed by the roots. It is now realized that agriculture does not only refer to crop production but also to various other factors that are responsible for crop production. These factors had been previously overlooked completely. Factors such as soil destruction, top soil erosion and the adverse effect of the prolonged use of chemical fertilizers on the soil health have been neglected (Ismail, 2005). The effects of pesticides on soil and human health have also been ignored. This has altered the physiological process of crops, diminished food quality, destroyed soil biota and promoted resistant varieties of insects pests. Soon the increased use of fertilizers, pesticides and farm machinery resulted in nitrate enrichment of ground waters, river waters and estuaries and release of ammonia and nitrous oxide to the atmosphere, the former added to the problem of acid rain, while the latter led to the reduction of ozone layer (Prasad, 2005).

In order to overcome all these unwanted factors the alternate agriculture practices such as Organic farming, ecofarming, biodynamic farming and traditional farming practices are considered as an important alternatives to increase soil fertility and soil health. In organic farming the application of organic manure especially vermicompost derived from earthworm is recommended. It is ecofriendly, non-toxic, consumes low energy input for composting and is a recycled biological product (Lourduraj and Yadav, 2005). Earthworms are physically aerators, crushers and mixers; chemically degraders; and biologically stimulators in the decomposer system (Prabha *et al.,* 2007). They effectively harness the beneficial soil micro flora (Lee, 1985; Tomati *et al.,* 1987), destroy soil pathogens and convert organic wastes into vitamins, enzymes, antibiotics, growth hormones and protein rich casts. Earthworm bioreactors have an in house supply of enzymes such as amylase, cellulase, nitrate reductase, acid and alkaline phosphatases. These enzymes enhance the biodegradation of the complex biomolecules into simple compounds (Prabha *et al.,* 2007).

Vermicomposts are organic materials, broken down by interactions between earthworms and microorganism, in a mesophilic process (up to 25ºC), to produce fully stabilized organic soil amendments with low C: N ratios. They have a high and diverse microbial and enzymatic activity, fine particulate structure, good moisture-holding capacity, and contain nutrients such as N, P, K, Ca and Mg in forms readily taken up by plants (Lavelle and Martin, 1992; Prabha *et al.,* 2005; Arancon and Edwards, 2009). Vermicompost is a good substitute for commercial fertilizers and has more N, P and K than the normal heap manure (Srivastava and Beohar, 2004). Besides that, earthworms release vitamins such as vitamins A,$B_1$, $B_2$, $B_3$, C and E in the vermicompost (Prabha, 2007; Ramasamy, 2009), B group vitamins (Gavrilov, 1963), some provitamin D (Zrazhevwkii, 1957), vitamin $B_{12}$ (Atlavinyte and Daciulyte, 1969) and free amino acids (Dubash and Ganti, 1964) in the soil. Though number of literatures on study on the influence of vermicompost on growth of different plant varieties is available, very few studies on influence of vermicompost on the growth status of sunflower plant have been carried out. So, the present investigation has been done to study the influence of vermicompost on the root status of the sunflower plant.

## MATERIAL AND METHODS

### Collection and culturing of earthworms

The earthworm, *Eudrilus eugeniae* was collected from worm farm, Kondegoundam-palayam village, Pollachi Taluk, Coimbatore District, Tamil Nadu, India and cultured at Kongunadu Arts and Science College premises, Coimbatore, India.

The collected earthworms were acclimatized under the laboratory condition for a period of three months by providing predecomposed cow dung as feeding material in the cement tank. The water was sprinkled on alternate days to maintain the optimum (60-70%) moisture content and temperature ranges between 25ºC and 30ºC by using hygrometer and thermometer respectively. Care was taken to avoid the entry of natural enemies. At the end of 75 days vermicompost was collected and stored in a shady place.

Different percentages of vermicompost (25%, 50%, 75% and 100%) were prepared by mixing red soil (w/w) (collected from Kanuvai village situated 10 km north of Coimbatore where intensive cultivation is going on) in flats (2.5m length x 75cm breadth x 60cm height) for the Sunflower plant (*Helianthus annuus* L.). 10 sunflower plants were cultivated in each flats with 40cm inter-plant distance and 20cm row to row distance for 30, 60 and 90 days period of exposures. The control plant was also grown in the red soil alone separately for a period of 90 days. The plants were watered daily and at the end of 30, 60 and 90 days period of exposures the plants were sacrificed and the root numbers were counted and the root length were measured using scale and the values were expressed as cm. The experiment was repeated six times. The result of the influence of different percentages of vermicompost on the root numbers and length were analyzed by employing Duncan's multiple range test (DMRT).

## RESULTS

The study on the influence of vermicompost on root number and length of Sunflower plant revealed that root number 45.54 ± 1.43, 75.09 ± 1.91, 93.01 ± 1.80; root length 55.87 ± 0.92cm, 80.83 ± 1.54cm, 93.18 ± 0.44cm were noticed higher in 75% vermicompost concentration at 30, 60 and 90 days periods of exposures respectively. At the same time, minimum root numbers were noticed in control (18.49 ± 1.29, 26.27 ± 1.64 and 32.74 ± 1.79 respectively) and 100% vermicompost concentration (19.62 ± 1.18, 25.77 ± 1.15 and 31.96 ± 1.90 respectively) at 30, 60 and 90 days period of exposures whereas minimum root length were noticed in control plants tested at 30, 60 and 90 days period of exposures respectively. The

**Table 1.** Influence of vermicompost on the Root numbers and Length of the Sunflower plant (*Helianthus annus* L.)

| Exposure period (in days) | % of Vermicompost | Root numbers | Root length (cm) |
|---|---|---|---|
| 30 | Control | 18.49 ± 1.29 | 15.14 ± 0.56 |
| | 25 | 27.08 ± 1.81 | 30.24 ± 1.44 |
| | 50 | 39.14 ± 1.78 | 37.96 ± 0.98 |
| | 75 | 45.54 ± 1.43 | 55.87 ± 0.92 |
| | 100 | 19.62 ± 1.18 | 14.24 ± 0.63 |
| 60 | Control | 26.27 ± 1.64 | 22.57 ± 0.62 |
| | 25 | 49.90 ± 1.71 | 45.64 ± 0.74 |
| | 50 | 71.14 ± 1.74 | 54.32 ± 1.13 |
| | 75 | 75.09 ± 1.91 | 80.83 ± 1.54 |
| | 100 | 25.77 ± 1.15 | 22.89 ± 0.80 |
| 90 | Control | 32.74 ± 1.79 | 33.52 ± 0.78 |
| | 25 | 70.73 ± 1.38 | 57.71 ± 0.87 |
| | 50 | 84.09 ± 1.80 | 77.93 ± 1.05 |
| | 75 | 93.01 ± 1.80 | 93.18 ± 0.44 |
| | 100 | 31.96 ± 1.90 | 27.97 ± 0.24 |
| | CD ($P<0.01$) | 3.325 | 1.207 |

Values are expressed by mean ± SD of six samples present investigation proved that the root number and length of sunflower plant increased upto 75% vermicompost concentration and thereafter the root number and length showed marked decrease in 100% vermicompost concentration. Statistically the values were found to be significant at 1% level (Table 1).

## DISCUSSION

In the present study, it has been revealed that the 75% vermicompost highly influenced the root number and length of the sunflower plant. It could be suggested that the 75% vermicompost concentration may be optimum for the better development of root system of the sunflower. This may be due to the presence of optimum level of macro and micro nutrients, plant growth hormones, plant enzymes and vitamins. Growth and development of crops depend largely on the development of root system (Hossain and Hamid, 2007). Plant roots are responsible for nutrient and water uptake and provide physical support to the plant. Most of the root system is made of lateral roots that originate postembryonically. Lateral root development is controlled by different factors including nutrient concentration in the plant and the soil (Lopez-Bucio *et al.,* 2003). Hormones are chemicals produced by one part of a plant and transported to another part of the plant where they cause a reaction to occur. Hormones are stored within the plant until they are needed. They are transported via phloem and other tissues. Hormones are released in small concentrations. They are released to all cells but only specific cells will react because they have special receptors for each hormone and they perform specific functions (Ross *et al.,* 1992; Mauseth, 1998; Raven *et al.,* 1999).

The higher growth of various plant characteristics in vermicompost compared to other treatment was not only because of the presence of greater amount of most of the plant nutrients but also due to the presence of microbial metabolites, the plant-growth promoting hormone-like substances. The earthworm casts and vermicompost influenced the development of the plants and promoted stem elongation, root initiation and root biomass, which suggest the linkage between biological effects of vermicompost and microbial metabolites that influence the plant growth and development (Tomati *et al.,* 1995). High auxin levels promote the formation of both later and adventitious roots. Lateral roots originate from cell in the pericycle meanwhile adventitious roots can be initiated in a variety of locations from mature cells that begin to divide and develop into a root apical meristem (Taiz and Zeiger, 1991).

It has been confirmed that auxin is needed for initiation of adventitious roots on stems and either applied for endogenous auxin is required for the first root initial cells to divide. In general a high auxin and low cytokinin ratio favours formation of adventitious roots (Hartmann *et al.,* 2002). There are exceptions from the dual requirements for auxin and cytokinin. Some plants may have high endogenous auxin and others require the addition of auxin but not cytokinin (Dodds and Roberts, 1995). Some observations on natural levels of auxin suggest that low endogenous auxin levels are required for root initiation, but high levels of root growth (George, 1993).

The metabolism of the exogenously provided auxin, especially its combination with phenolic compounds, has been considered in relation to the promotion of adventitious rooting (Haissig, 1974; Weisman *et al.,* 1988). The fall in IAA-oxidase activity and the rise in the endogenous auxin protector level indicate that auxin is necessary for rooting induction, confirming previous results (Quoirin *et al.,* 1974; Liu *et al.,* 1996). Indole-3-acetic acid (IAA) is the main auxin in plants, controlling many important physiological processes including cell enlargement and division, tissue differentiation, and responses to light and gravity (Taiz and Zeiger, 1998). Bacterial IAA producers (BIPs) have the potential to interfere with any of these processes by input of IAA into the plant's auxin pool. The consequence for the plant is usually a function of (i) the amount of IAA that is produced and (ii) the sensitivity of the plant tissue to changes in IAA concentration. A root, for instance, is one of the plant's organs that is most sensitive to fluctuations in IAA, and its response to increasing amounts of exogenous IAA extends from elongation of the primary root, formation of lateral and adventitious roots, to growth cessation

(Davies, 1995). Besides that, it could be suggested that the minimum root number and length noticed in 100% vermicompost may be due to the presence of large amount of inorganic salts in 100% vermicompost (Arancon and Edwards, 2009).

## CONCLUSION

The present investigation reveals that 75% vermicompost concentration highly influences the root system of the sunflower plant. It has been concluded that the above mentioned vermicompost concentration could be utilized for the better growth of the plant.

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