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Influence of Vermicompost on Germination of Indian Butter Bean Plant (*Dolichos lab lab* L.)

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The continuous use of cultivable land has led to depletion in the fertility status of soil. In order to fertilize the land as well to increase the agricultural production to face the food scarcity in accordance with the increasing population, modern agricultural operation known as green revolution was introduced. Vermicompost is a rich source of macronutrients, micronutrients, vitamins, plant enzymes, plant growth hormones and beneficial microorganisms. So, the present research work has been done to study the influence of vermicompost on the germination of Indian butter bean plant (*Doliochos lab lab* L.). Different percentages of vermicompost (25, 50, 75 and 100%) derived from the earthworm, *Eudrilus eugeniae* was made with red soil. The healthy seeds of Indian butter bean plant were sown in these vermicompost-red soil mixtures and the percentage of germination was observed upto 30 days period of exposures. The maximum germination (96.69%) and early germination (5.33 days) were noticed in 50% vermicompost concentration when compared to other concentration tested whereas the minimum germination (43.20%) and late germination (7.67 days) were noticed in control plants tested. The difference was found to be statistically significant at 1% level.

Key words: *Eudrilus eugeniae*, vermicompost, Indian butter bean, Germination.

In agricultural land depletion of soil fertility 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 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

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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. The survey of literatures revealed that study on the influence of vermicompost on the germination of Indian butter bean plant is very limited. So, the present investigation has been carried out to study the influence of vermicompost on the germination of the Indian butter bean plant.

MATERIAL AND METHODS

Collection and culturing of earthworms

The earthworm, *Eudrilus eugeniae* was collected from worm farm, Kondegoundampalayam village, Pollachi Taluk, Coimbatore District, Tamil Nadu, India and cultured at Kongunadu Arts and Science College premises, Coimbatore-29, Tamil Nadu, 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 (1.5m length x 1m breadth x 60cm height) for the Indian butter bean plant (*Dolichos lab lab*). The healthy seeds of the Indian butter bean plant were collected from Frooke nursery, State Bank of India Road, Coimbatore, India. 10 seeds were sown in each flat with 20cm inter-plant distance in two rows (50cm row to row distance) for 30 days period of exposures. The control experiment was also carried out in the red soil alone separately for a period of 30 days. The flats were watered daily. The germination count was done in different period of exposure in each percentage of vermicompost. The experiment was repeated six times. The result of the influence of different percentages of vermicompost on germination was analyzed by employing Duncan's multiple range test (DMRT). Germination percentage was done as mentioned below.

Germination percentage

The percentage of germination was calculated using the formula as described by the method of Vavrek and Campbell (2002).

$$\text{Percentage germination} = \frac{\text{Number of seeds germinated}}{\text{Number of seeds sown}} \times 100$$

RESULTS AND DISCUSSION

The influence of vermicompost on the germination of Indian butter plant study revealed that the percentage of germination increased upto 50% vermicompost concentration (25% v.c-, 90.00%; 50% v.c-96.60%) and thereafter the germination rate declined in 75% (93.20%) and 100% (73.20%) vermicompost concentration. Similarly, the early germination (5.33 days) and late germination (7.67 days) were noticed in 50% vermicompost concentration and control respectively. The present study revealed the same concentration of vermicompost (50%) induced the maximum germination and early germination. The investigation proved that the 50% vermicompost concentration may be optimum for the maximum germination of the Indian butter bean plant. At the same time, when the concentration of vermicompost increases beyond 50% vermicompost the rate of germination decreases. This may be due to the presence of high level of inorganic salts (Arancon and Edwards, 2009), macro and micro nutrients and plant growth hormones in the vermicompost. The values were found to be statistically significant at 1% level (Table 1). This may be due to the need and requirement of nutrients and growth hormones for the growth of the plants. The uptake of the nutrients by plant may differ from one concentration of vermicompost to other. In addition to that though nutritional availability is

Table 1. Influence of vermicompost on the period and percentage of germination in Indian butter bean plant (*Dilochos lab lab* L.)

Percentage of vermicompost	No. of seed sown	Number of days for germination	Percentage of germination
Control	10	7.67 ± 1.21^a	43.20 ± 1.22^a
25%		7.17 ± 1.17^a	90.00 ± 2.45^b
50%		5.33 ± 1.21^b	96.60 ± 1.66^c
75%		7.33 ± 1.63^a	93.20 ± 2.96^d
100%		7.17 ± 1.47^a	73.20 ± 1.55^e
CD($p<0.01$)		2.17	2.268

Values are expressed by mean ± SD of six samples; Mean followed by a common superscript alphabet are not Significant at 1% level by using DMRT analysis.

rich in vermicompost, the plant utilizable quantity also differs from one concentration of vermicompost to other. In this juncture, the physiology and biochemical activity of the plant are not similar to one particular concentration of vermicompost to other. This may be the major reason that the plant germinated and grew well in particular concentration of vermicompost concentration whereas others not.

In support of the present study, Nikolic et al (2006) reported that the viability of seeds in different plant species is highly variable, ranging from a few days to many years. Germination capacity depends on the species and external conditions, while the physiological state of seeds also plays a very significant role in this process. Besides that it has been reported that the endosperm often acts as a barrier to seed germination, playing a part in seed coat dormancy or in the germination process (http://www.seedbiology.de/dormancy.asp).

In the present study, the vermicompost analysis showed the presence of plant growth hormones like Gibberelic acid, Indole acetic acid, Indole butyric acid and Naphthalene acetic acid. These hormones might have induced seed germination. Evidently, the report of Karthireasan and Moorthy (1994) indicated that the use of exogenous GA3 accelerates seed germination in Mangrove species. It was also demonstrated that residual products of earthworms in their casts break the dormancy in jute which otherwise need to be steeped before it can germinate (Ayanlaja et al., 2001). Besides that Owa et al (2008) reported that earthworm products are probably involved in nutrient utilization of the catabolic products of the endosperm such that the cell proliferation and elongation in the embryo are facilitated. They also reported that the earthworm products must have therefore been introducing an additional factor, which may have part in causing breakdown of seed coat to facilitate germination. In addition to that they have also suggested that earthworm products make seed testa more permeable to water and ions. Salisbury and Ross (1992) reported that as the seed imbibes water the embryo produces GA. This induces synthesis of amylase in the aleurone layer which secretes the enzyme to the endosperm. Amylase breaks down starch to glucose which diffuses to the embryo and is used for the early stages of plant growth.

Gibberelic acid releases seed dormancy by increasing the embryo growth potential, and/or weakening the seed coat so the radical of the seedling can break through the seed coat. Different types of seed coats can be made up of living or dead cells and both types can be influenced by hormones; those composed of living cells are acted upon after seed formation while the seed coats composed of dead cells can be influenced by hormones during the formation of the seed coat. ABA affects testa or seed coat growth characteristics, including thickness, and effects of GA-mediated embryo growth potential. These conditions and effects occur during the formation of the seed, often in response to environmental conditions. Hormones also mediate endosperm dormancy. Endosperm in most seeds is composed of living tissue that can actively respond to hormones generated by the embryo (http://www.seedbiology.de/dormancy.asp).

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