

**PERFORMANCE EVALUATION OF NATIVE AND EXOTIC SPECIES OF
EARTHWORMS FOR AGRO-HORTICULTURAL WASTE MANAGEMENT**

by

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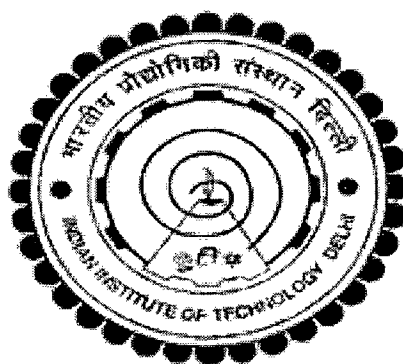
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CERTIFICATE

This is to certify that the thesis entitled “**Performance evaluation of Native and Exotic species of earthworms for agro-horticultural waste management**” being submitted by **Ms. Payal Garg** to the Indian Institute of Technology, Delhi for the award of the degree of Doctor of Philosophy is a record of bonafide research work carried by her. Ms. Payal Garg worked under our guidance and supervision, and has fulfilled the requirements for the submission of this thesis, which to our knowledge has reached the required standard.

The results contained in this thesis have not been submitted in part or in full to any other university or institute for award of any degree or Diploma.


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We meditate on the glory of the Creator;

Who has created the Universe;

Who is worthy of Worship;

Who is the embodiment of Knowledge and Light;

Who is the remover of all Sin and Ignorances;

May He enlighten our Intellect.

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ABSTRACT

Earthworms are important organisms helping nature to maintain nutrient flow from one system to another and also minimize environmental degradation. Recently, use of native earthworms in waste management has been recognized as it has inbuilt eco- sustainability features and would offer a solution to the possible conflicts between the basic characteristics of native and exotic earthworm species. In this context, present study was taken up with the following major objectives: (i) Identification and selection of suitable native species of earthworms in a rural area. (ii) Comparative study on the growth characteristics and heavy metal tolerance of exotic and native earthworm species. (iii) To enhance the multiplication of native earthworm species by growth promoters and bioinoculants. (iv) Production and characterization of vermicompost and vermiwash produced by native and exotic species of earthworms. (v) Field evaluation of vermicompost and vermiwash prepared by both earthworm species on selected crops.

To begin with, collection and identification of native earthworm species prevalent in the study area (agricultural area adjacent to Jeevan Vidya Trust, village Govindpur, Bijnore district, (U.P.) was done. Total 8 species were found prevailing in the study area and among these, Allolobophora parva (A. parva) was found more distributed and hence it was selected for further studies. The results of preliminary investigation revealed that total number of E. fetida (exotic species) was found higher in substrate (without soil) while in case of A. parva, maximum growth was observed in the substrate having 30% soil. The growth of both types of earthworms was found higher during monsoon season. On the basis of comparative study of native and exotic earthworms under different survival conditions it was found that for both species the optimum temperature, moisture content and pH were 30°C, 65-70% and 7.5 respectively. In this context it may be noted that though the multiplication of A. parva is slow than E. fetida but fold increase in weight of A. parva was higher than E. fetida. This interesting experimental observation would help in assessing the true potential of native earthworm species and scope of further enhancement using bioformulation and bioinoculants.

In order to enhance the multiplication of earthworms, certain growth promoters and bioinoculants were tried. Homeo-formulation (SSY1), as growth stimulant produced better results than BD formulation and bioinoculant (Azotobacter chroococcum). 1ml (SSY1)/2 Kg of substrate was found optimum for enhancing the multiplication (10.6 fold) of A. parva. The results of vermicomposting experiments (A.parva) using leaf litter mixture, Putranjiva roxburghii and sugarcane trash based substrate with Homeo formulation (SSY1) clearly indicated that total

nitrogen content (1.2%) was maximum in vermicompost of leaf litter mixture followed by sugarcane trash (0.85%) and *P. roxburghii* (0.78%). However, TP and TK in different vermicompost were found in the order: sugarcane trash>leaf litter mixture>*P. roxburghii*. In most cases NPK content in vermicompost by *A. parva* was found either more or at par with the vermicompost prepared by *E. fetida*. Experimental findings on the relative heavy metal accumulation and tolerance of exotic and native earthworm species unveiled a very interesting fact. The native earthworm *A. parva* exhibited higher tolerance, better survival and growth in heavy metal contaminated leaf litter based substrate as compared to the exotic species.

The results of Vermiwash revealed that vermiwash prepared by native species of earthworms showed significantly more N (0.22%), P (0.33%), minor nutrients (ppm) {Cu (0.24), Fe (1.82), Mn (0.53), Zn (0.06), Na (128), Ca (222), Mg (201)} and total phenolic content (48ppm) in comparison to vermiwash prepared by exotic earthworms. Bioassay results clearly show that the pest of okra crop (*Spilosoma obliqua*) can be controlled by vermiwash/cowurine only at the initial stage (i.e. 2nd instar larvae), providing guidelines for vermiwash application in vegetable crops.

The data of preliminary investigation by conducting field trials using vermicompost (prepared by native and exotic earthworms) for a pulse crop (*Vigna mungo*) under controlled conditions indicated that, total crop yield was found significantly higher (~10%) in case of vermicompost prepared by native earthworms than exotic earthworms in both the varieties of seeds (local and T-9). In case of a vegetable crop (Okra), vermicompost along with spray of 10 and 20% concentration of vermiwash (prepared by both species of earthworms) was found to be more effective in achieving higher yield of okra fruit (~8%) than control.

In toto, the present study brings out the fact that the use of native earthworm species by adding bioformulation/bioinoculants in the substrate for enhancing their multiplication can be successfully employed in vermicomposting of agro-horticultural waste. The experimental findings have certainly helped us in understanding the potential and significance of native earthworms in waste management while preserving the local biodiversity- a distinct merit of native earthworms over exotic species. This aspect needs to be highlighted by linking the 'waste management and nutrient recycling system' to sustainable agriculture. Present investigation is a small drop in the ocean for exploring the potential of native earthworm species in terms of eco-sustainability and economical feasibility for achieving rural prosperity.

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