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Editorial

Earthworms: Know their capacity

Earthworms are really unique creatures on the planet. Some of their species boost up the soil quality and other transform the biodegradable wastes in to vermicompost. In addition, these are immensely important for the human health. Recent studies showed that these have a highly vibrant and efficient immune system which might be utilized to induce human immune system. The article "Innate Immune Response in *Eudrilus eugeniae* to Gram Negative Microbes" of S. Umamaheswari suggest that earthworm extract is a potential agent for the use in bone regeneration.

The real role of earthworms in the augmentation of crop-yield is known to us but best known to our progressive farmers. These farmers culture various species of earthworms in the agrarian fields, transform bio-degradable wastes like, cattle dung, leaf and plant litters, kitchen waste and crop waste etc. in to Vermi-compost and apply the transformed manure in the crop-fields and achieve the new horizon of yields with more profit. Such farmers are saluted by the whole human society as these are engaged in the cleaning of environment on one side and by producing chemical free crops, fruits and vegetables on the other. **VERMECO** is saluting such farmers too by publishing their major work in the field of organic farming. In this issue, Shri Jung Bahadur Singh is one of such farmers.

Credibility of earthworms is assessed by our biologists. They are the real friends of earthworms. These biologists provide the name and fame to the earthworms. Dr. Sultan Ahmed Ismail is one of the known biologists of India and a real friend of earthworms. **VERMECO** always favors such persons by publishing their achievements and honors who are engaged in knowing the unknown facts of earthworms, their ecology in different agrarian systems.

Prof. S.M. Singh



Message from the President

Good health is considered as one of the prime gifts of God. '**HEALTH**' depends upon Hygienic conditions of our surroundings. These will only prevail when our Environmental conditions are well enough. The quality of Air that we breathe should be fairly pollution free and the agricultural Land be ideal having all the necessary nutrients and with no residues of toxic substances which are regularly accumulated due to their usages by the farmers in to their farming land in saving from the crop pests. We must have positive Thinking and Harmonious nature to live together.

To maintain the hygienic conditions, we have to preserve the agricultural sustainability in terms of maintaining physico-chemical and biological parameters of the soil by adding green, organic manures and Vermicompost as bio-fertilizers and Vermi-filter, Vermi-wash and Vermi-tea as biopesticides. This practice should be propagated at a wider level by organizing awareness programs and publishing and circulating lucid articles on organic farming along with easy methods of preparing organic manures and their various sources using earthworms.

I am happy that the Center for Vermiculture and Vermicomposting of the Department of Animal Science of the University is regularly publishing and circulating a biannual bulletin "**VERMECO**" on Agricultural Sustainability and Rural Development since more than a decade. I hope that all the articles of the bulletin would be of immense importance to whole of the scientific community, soil biologists and the farmers of the country and abroad.

Prof. Anil Shukla

Vice Chancellor

Mahatma Jyotiba Phule Rohilkhand
University, Bareilly (India)



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Innate Immune Response in *Eudrilus eugeniae* to Gram Negative Microbes

Earthworms promise to provide cheaper solutions to several social, economic and environmental problems plaguing the human society. Earthworms can safely manage all municipal and industrial organic wastes including sewage sludge and divert them from ending up in the landfills. Their bodies work as a 'biofilter' and they can 'purify' and also 'disinfect' and 'detoxify' municipal and several industrial wastewater. These worms can reduce the



BOD and COD loads and the TDSS of wastewater significantly. They can even remove the Endocrine Disrupting Chemicals (EDC's) from sewage which is not removed by the conventional sewage treatment plants. Earthworms can bio-accumulate and bio-transform many chemical contaminants including heavy metals and organic pollutants in soil and clean-up the contaminated lands for re-development. Earthworms restore and improve soil fertility by their secretions (growth hormones) and excreta (vermicast with beneficial soil microbes) facilitating the boost up in crop productivity. They have potential to replace the environmentally destructive chemical fertilizers from farm production. The protein rich' earthworm biomass is being used for production of nutritive feed materials for fishery, dairy and poultry industries. They are also being used as raw materials for rubber, lubricant and detergent industries. The bioactive compounds isolated from earthworms are finding new uses in production of 'life saving medicines' for cardiovascular diseases and cancer cure (Rajiv K. Sinha *et al.*, 2010). Looking into their importance, a study was conducted to enumerate the microbial load in the earthworm, *E. eugeniae* by injecting specific antigen *E. coli* pGLO (florescent plasmid).

Immune response of the gut cleared earthworm was determined by injecting specific antigen *E. coli* pGLO. A loopful of *E. coli* pGLO culture was inoculated into the sterile nutrient broth and incubated at 37°C for overnight. The overnight culture of *E. coli* pGLO (30µl) was injected in the clitellum region of earthworm. After 5 minutes, 24, 48 and 72 hours of *E. coli* pGLO injection, the clitellum of the worm was crushed, serially diluted till 10⁻⁴ dilution. Spread plating of the undiluted and diluted aliquots were plated on Nutrient agar plates subjected to incubation at 37°C for 24 hours and the fluorescent colonies were enumerated under Ultraviolet light.

On 1st day, *E. coli* pGLO bacterial load of 3x10¹ CFU/ml was noticed in the undiluted earthworm which was decreased to 2x10²CFU/ml and 1x10¹ CFU/ml on 2nd and 3rd day respectively. The complete removal of

all bacteria was observed on the 4th day. *E. coli* pGLO in the diluted (10⁻²) earthworm sample showed a bacterial load of 3x10⁴ CFU/ml on 1st day which was found to be increased to till to 7x10³ CFU/ml

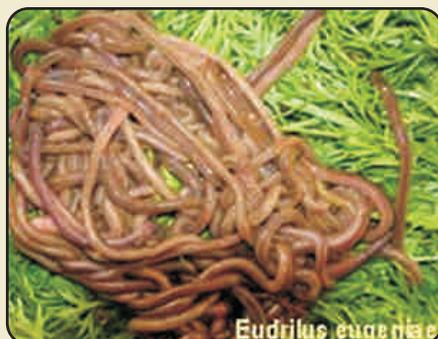
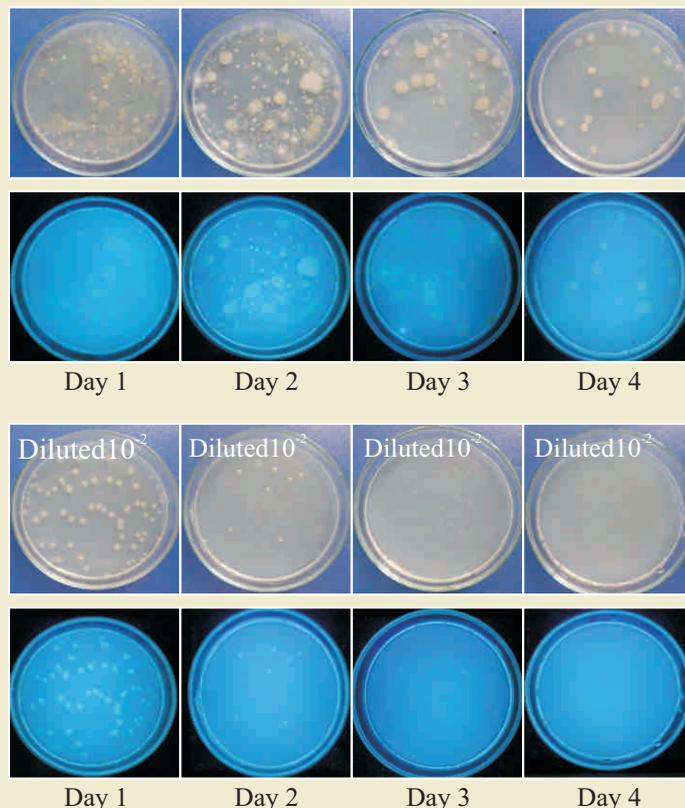


Table -1: Enumeration of microbial load in earthworm injected with *E. coli* pGLO on Nutrient Agar Plates

S. No.	Dilutions	No. of colonies (CFU/ml)							
		Day 1		Day 2		Day 3		Day 4	
		<i>E. coli</i> pGLO	Others	<i>E. coli</i> pGLO	Others	<i>E. coli</i> pGLO	Others	<i>E. coli</i> pGLO	Others
1	Undiluted	3x10 ¹	TNTC	2x10 ²	9x10 ²	1x10 ¹	7x10 ²	-	-
2	10 ⁻²	3x10 ⁴	5x10 ⁵	7x10 ³	-	-	-	-	-

Fig. 1: Enumeration of microbial load in earthworm injected with *E. coli* pGLO.



on 2nd day. Complete removal of all the bacterial colonies were noticed on 3rd and 4th day (Fig.1 & Table -1).

This work throws the light on the nature of immune system in the earthworm, *Eudrilus eugeniae*. The humoral and cellular components in the coelomic fluid of earthworms contribute to work as specific and non-specific mechanism in offering immunity (Roch and Cooper, 1991). The coelomic fluid of earthworm is known to contain a variety of humoral factors topotential pathogens that may migrate from the environment into its body.

This work focuses on the mechanism of removal of bacteria from the body cavity of the earthworm. The bacteria *E. coli* pGLO was injected into the clitellum of earthworm at different time intervals viz., 5 minutes, 24, 48, 72 hours and the injected regions were dissected and crushed using 1ml of 1X PBS, serially diluted and plated in Nutrient agar plates. Within 48 and 72 hours the earthworm was found to eliminate all the bacteria from its body cavity. Dorothy Wrigley *et al.*, (2007) studied the clearance of *K. pneumoniae* from coelomic cavity of earthworm, *Eisenia fetida* and reported the need for four days to eliminate all bacteria from

the coelomic cavity. But the normal micro biota present in the earthworm body also got eliminated. If the earthworm had specific immunity it should have removed only the injected antigen, but the elimination of normal micro biota suggests the existence of non-specific immunity in the earthworm. This work emphasizes on the methods to quantify the innate immune response in *Eudrilus eugeniae* by injecting microbial antigen, *E. coli* pGLO.

The study showed that earthworms secrete many unspecified components which get eliminated with the injected foreign particles. These unspecified components might be used in the formulation of pharmaceutical and preliminary drugs due to the possibility of harbouring of proteolytic, haemolytic,

anticoagulation and antibacterial activity. Body tissues of earthworms have possessed high range of immunogenic components but the coelomic fluid renders a low level of immunogenic components. The present study indicates that the *E. coli* pGLO injected coelomic fluid exhibited a high level of immunogenic components. This confirms the existence of a highly vibrant and efficient immune system in earthworms which might be utilized to induce human immune system. Earthworm extract has beneficial effects on bone cell cultures indicating that earthworm extract is a potential agent for use in bone regeneration (Yuan-Tsung Fu *et al.*, 2014).

S. Murugan & S. Umamaheswari* - Associate Professor, Department of Biotechnology, Manonmaniam Sundaranar University, Tirunelveli-627 012(TN)

KNOW OUR PROGRESSIVE FARMER

Shri Jung Bahadur Singh

Shri Jung Bahadur Singh- a progressive organic farmer of Bareilly District, did 10+2 education in Science and is engaged in the wide-level farming of Shimla mirch (*Capsicum annum*), by applying modern Integrated Pest Management methods and using organic manures. He is culturing compost worms and producing vermicompost at large scale in his farm house.



Shri Singh is very active in participating different training programs; always have communication with other progressive farmers. He is a regular visitor of different Research Institutions and Agricultural Universities and has discussions with subject experts regarding progressive farming systems.

He always applies new techniques as suggested by the subject experts and uses his farming land as an experimental laboratory. He has got regular and active support from Operation Research Projects from ICAR, G.B. Pant University of Agriculture and Technology, Pantnagar (Uttarakhand), Krishi Vigyan Kendra's, IVRI, Izatnagar, IPM Laboratory, Bilba (Bareilly), Sardar Vallabh Bhai Patel University of Agriculture and Technology, Meerut (Uttar Pradesh), U.P. Desk Project, Bareilly and Mother Dairy, Delhi.

Mr. Singh regularly solarizes the soil in the poly house for sowing the early crops. He is also preparing seeds, seedlings and soil by *Trichoderma* and using IPM techniques like Pheromones traps, Trichogramma and BT and NPV as Bio-agents.

He is growing Marigold (*Tagtus erecta*), Garlic, and Coriander crops as trap lamps and purifying soil by neem cake powder. He is applying vermicompost, Nadup compost and green manure in the soil in place of chemical fertilizers and pesticides.

He has developed "Fruit and Vegetable Association" in Bareilly for proper marketing of the products from the farmers to get better cost of the agrarian products.

His Achievements:

- The maximum production of Shimla Mirch was achieved by applying chemical fertilizers and vermicompost (VC) in 1:1 ratio.
- Disease less crops and plant products were developed from those experimental areas where either VC or NADUP or simple dung manure was applied but crop production was nearly half than that of those where chemical fertilizers and VC was used in the ratio of 1:1.
- The Shimla Mirch crop was grown maximally diseased where only chemical fertilizers were applied.

His Suggestions:

The marginal farmers could earn more money by growing seasonal vegetables and by applying organic manures like Vermicompost. This practice could benefit them from the two sources: One source of income may be from the sale of organic vegetables at higher prices and the other from the sale of excess of vermicompost to other farmers.

He has improved the crop quality by using organic fertilizers and manures, owned the crown of various honors, distinctions and achievements as one of the renowned progressive farmers of Bareilly district. He got the prize for the record production of Shimla mirch (@ 172 Q/Acre) in 1997 in Uttar Pradesh. Got prize for the maximum quality production of Shimla mirch by Mother Dairy and Vegetable Project, Delhi in 1997-98, for the maximum production of Indian spices of Shimla mirch by Indo-American Hybrid seeds Corporation in 1999; for Biological control of pests using IPM techniques by IPM Lab. Bilba in 2000 and received the 1st prize by Kisan Samman Yozna of Uttar Pradesh as 'Udyan Ratna' in 2002. He was also honored by IVRI, Izatnagar on "Kisan Divash" for opting organic farming on a large scale.

In the real sense, he is an Institution of new ideas, thoughts, and perceptions in developing culture of organic farming in agriculture.

VERMECO wishes a healthy long life to such farmers whose interest is only and only for the betterment and healthy life of whole of the Human population.



Indian Earthworm Biologist-11 Dr. Sultan Ahmed Ismail (b.1951)

Dr. Ismail is a well-known Indian Soil Biologist and Ecologist. He did B.Sc. in 1972, M.Sc. in 1974, M. Phil. in 1978, Ph.D. in 1984 & D.Sc. in 2001 in Zoology (Soil Ecology) from the University of Madras. He started his carrier as Demonstrator in the Department of Zoology at the New College, Chennai from 1974 to 75. He served as Lecturer in Zoology in the same College from 1975 to 87 and Reader in the Department Zoology in NCERT, Government of India from 1987-90. He again served as Reader in Zoology from 1990-2001 as well as Vice-Principal in the New College from 2000-01. He had also taken the additional charge of Director of the Institute of Research in Soil Biology and Biotechnology at the College from 1986 to 2001. Dr. Sultan worked as Deputy Director at Shri AMMMCRC, Chennai from 2001 to 2002; Research Director (Honorary) at Dr. MGR Janaki College, Chennai from 2002-2013; Head, Department of Biotechnology again in the New College Chennai from 2004 to 2013.

He edited 12 Books on Earthworms, published 13 Review articles and 41 Original research papers in various International and National Journals of repute and organized 08 Symposia/Seminars at the International and National level. He had developed Vermi-tech technology which is extremely popular with farmers and urbanites, used to recycle garbage into extremely valuable fertilizer using local varieties of earthworms. He has two patents in "A pre-fabricated vermicompost plant and Process of preparation of paste for an anti-inflammatory drug".

Dr. Sultan has 39 year of teaching experience in P.G. and U.G. level. He supervised 32 M. Phil. and 17 Ph.D. students. In addition, he has developed Educational Software on "BLOOD CELL COUNT" on the BBC micro for NCERT and Local co-ordinator for the preparation of 28 Video Lessons in Zoology for the UGC, Government of India.; Vermitech: Harnessing earthworms for the benefit of mankind- Audio Visual Aids and Vermitech (in Hindi & Tamil). He has visited more than 18 foreign countries, Australia, Austria, Brunei Darussalam, Denmark, Greece, Iran, Japan, Saudi Arabia, Malaysia, Pakistan, Papua new Guinea, Philippines, Russia, Singapore, south Africa, Sri Lanka, UK and USA to participate views on the application of organic farming at the International forum.

His work has centered on techniques for recycling bio-degradable waste into fertilizers using local varieties of earthworms and on soil bioremediation. He worked with the D.S.T., Government of India in the development of a module on vermicomposting as a sustainable ecological practice for the children. He has conducted a project of Department of Environment and Forests, Government of Tamil Nadu state for implementing Vermicomposting in 50 schools in Madras (Chennai) and delivered several lectures in more than 200 schools in India and abroad on environmental awareness, solid waste management and vermicomposting.

Dr. Sultan did a lot of collaborative work in various Colleges, NGOs and the Universities. He worked with Tata Institute of Fundamental Research in 1982; University of Lancaster, UK in 1983 and 1996; B.J. Medical College, Pune from 1987-88; C.L.R.I., Chennai from 1991-92; ARISE, India from 1992-2003; Auroville, India from 1992-2005; EXNORA International, India, 1992; Miyazaki Medical College, Japan from 1993-2005; M. S. Swaminathan Research Foundation from 1993-2000; Soil & Water Research Institute, Iran in 1997; Miyazaki University, Japan in 1999-2000; CPCSEA, Government of India in 1999-2000.

Dr. Sultan is being honored as one of the Committee Members, Agricultural Renewal in India for a Sustainable Environment (ARISE), India from 1992 to 1998; Committee Member, Environmental Society of Madras, Chennai from 1995-97; Advisor, Environmental Objectives, EXNORA International, Chennai in 1994; Member, New York Academy of Sciences, USA from 1995-1998; Senator, Environmental

Objectives, EXNORA International, Chennai from 1996 to 1997; Vice President, EXNORA International, Chennai, from 1997 to 1998; National Expert on composting for the United Nations Industrial Development Corporation (UNIDO), Asia Programme from 1998 to 2000; Honorary Expert Consultant, Committee for Purpose of Control and Supervision of Experiments on Animals (CPCSEA), Ministry of Social Justice and Empowerment, Government of India from 1999 to 2002; Expert to draft chapters for vermicompost manual being prepared by UNICEF (2001); National Convener of the Alliance for Waste Management in 2003 and Advisor of Organic Farming Association of India (OFAI) (2009+).

He worked as Vice President, EXNORA International; Member, New York Academy of Sciences, USA; National Expert on Composting, UNIDO, Asia Programme; Member CPCSEA, Ministry of Social Justice and Empowerment, Govt. of India; Committee Member, Environmental Society of Madras, Chennai India; Chairman, Agricultural Renewal in India for a Sustainable Environment (ARISE); Member (Environment)- High Level Committee for the study of Rivers and Riverbeds as a result of sand quarrying, Government of Tamil Nadu; Chairman, High Court committee for wetland recognition (Tamil Nadu).

He bestowed for the various awards. He was honored with Vocational Service Award by the Rotary Club of Madras Metro (1992-93); EXNORA's Friend of the Environment Award presented by the Chief Minister of Tamil Nadu (1993); Commonwealth Association of Science Technology and Mathematics Educators (CASTME) Award (1994-95); Australia International Education Foundation's Visiting Fellowship (1996); Awards from CPR Environmental Education Centre (1998-99); Environmental Award from Green India Foundation (1999); Vocational Excellence Award by the Rotary Club of Besant Nager, Chennai (2002); ARAIGNAR Anna Award for Environmental Education and Awareness by the Department of Environment, Government of Tamil Nadu, India, (2005); Agriculture Leadership Award by the Bangalore University and the National Council for Organic farming, Government of India (2009); Award of Excellence by His Excellency Governor of Jharkhand (2010); Classified as one amongst the "TOP 10" people of Tamil Nadu by Anatha Vikathan (2013); Life-time Achievement Award by PABCET, Tiruchy (2014).

He has conducted various awareness programs in the development of a module on vermicomposting as a sustainable ecological practice to children associated with the DST, Government of India, New Delhi; delivered several lectures (may be for more than 20000 people so far) including more than 250 schools across the country creating awareness on environment, solid waste management and vermicomposting; coordinated in the development of "SIMPLE TASKS GREAT CONCEPTS" consisting of 100 Life-Science based experiments for children that any child can do even without a laboratory (2010); worked as a resource person for the National Children Science Congress held every year (from December 27-30) by NCSTC of DST of Government of India. In this program 10 workshops in 10 clusters were organized in South India during 2013-14.

Currently, Dr. Sultan is working on the anti-inflammatory properties of earthworms, ultra-structure of the penial setae and the electrical bio-luminescence of earthworms and also with the Consumer Association of Penang (CAP) to make an effort to promote awareness of organic farming, vermitech and waste management to educational institutions and organic farmers of Malaysia. Presently, he is the Director of Eco-science Research Foundation, Chennai.

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READER'S OPINION IS SOLICITED



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