Chapter 1

Introductory Chapter: Earthworms - The Ecological Engineers of Soil

Sajal Ray

Additional information is available at the end of the chapter

http://dx.doi.org/10.5772/intechopen.78264

1. A farmer's friend

Intimacy of human with earthworm has a long history. Hunter-gatherer mode of life style of primitive human faced the challenge of uncertainty of food for the alleviation of hunger. Primitive societies are thought to be solely dependent on collection of natural resources from forest, river, and other water bodies for survival. Such resources included both plants and animals with nutritional and medicinal significance. Early human invented, learnt, and improvised agricultural technologies in different regions of the planet. They observed that the silted river plains with adequate moisture content are extremely fertile for the growth of various crops. While practicing agriculture, they might have observed these moist bodied worms of soil and their casting heaps along the soil surface. During tilling, they unearthed and observed these worms, which are able to penetrate soil without much effort as and when necessary. They befriended these 'down to earth' worms, which were innocuous and beneficial for agricultural practice. Earthworms are the true friends of farmers and are capable of increasing porosity and fertility of agricultural soil by their natural activity. Traditional farmers rely on their indigenous knowledge base and experience, and care these worms for their professional interest. These slow moving, yet highly dynamic soil annelids are considered as one of the beneficial animals to human and an indicator of the general health of soil. Earthworms did not evolve vision and still are uniquely sensitive to microlevel shift in the quality of soil and other environmental parameters. Their sensitivity toward soil contaminants and selected ecological cues enabled them to act as source of biomarkers of toxin exposure to soil and water.

Intensive agricultural practices occasionally appear to be highly detrimental for the health of the soil and human [1]. Unrestricted application of fertilizers and pesticides pose a serious ecotoxicological threat for the earthworms of many developing countries. Earthworms feed along the soil surface and thus are exposed precariously to many agrotoxins-like pesticides and fertilizers. However, authors reported the enhancement of sustainability of agriculture by the effective management of earthworms of soil ecosystem. Earthworms, in general, are reported to improve porosity and structural stability of soil facilitating the healthy yield of crop. Thus, the earthworms are claimed as 'ecosystem engineers' of soil [2]. These ecological engineers bear a high potential to influence the quality and microenvironment of soil. Scientists report 'drilosphere,' as a part of soil with burrows and casts, are rich in earthworm and microbes. An intimate relationship of earthworm with microorganisms and invertebrates often determine the general biological structure of agricultural soil. Functional interaction of earthworm with these flora and fauna affect the interspecific dynamics and biological profile of soil ecosystem. In a review [2], the author highlighted the determining role of earthworm in pedogenesis, nutrient cycling, and fertility enhancement in soil. The earthworm efficiently transforms biodegradable organic waste materials into a vermicast – a bioprocessed end product rich in nutrients [3]. During passage of egested soil, the cast accumulates enzyme, microorganisms, and hormones from earthworm's gut involving a complex and dynamic process [4]. The biochemical process of vermicomposting is a dynamic and fragile event under the growing threat of soil contamination by new generation ecotoxins. Emerging group of pollutants includes a variety of chemical agents with unknown or less known level of toxicity and stability. This group of soil contaminants encompasses pharmaceutical compounds, nanotoxins, and selective bioactive compounds of industrial origin. In recent years, toxicity of various metal nanotoxins and inorganic salts were examined in earthworms. Immunological toxicity of copper nanoparticle and copper sulphate is in report [5] in a common variety of earthworm of India. Prior to toxicity analyses, physical characterization of copper oxide nanoparticle was carried out by dynamic light scattering, zeta potential, transmission electron microscopy, and EDAX

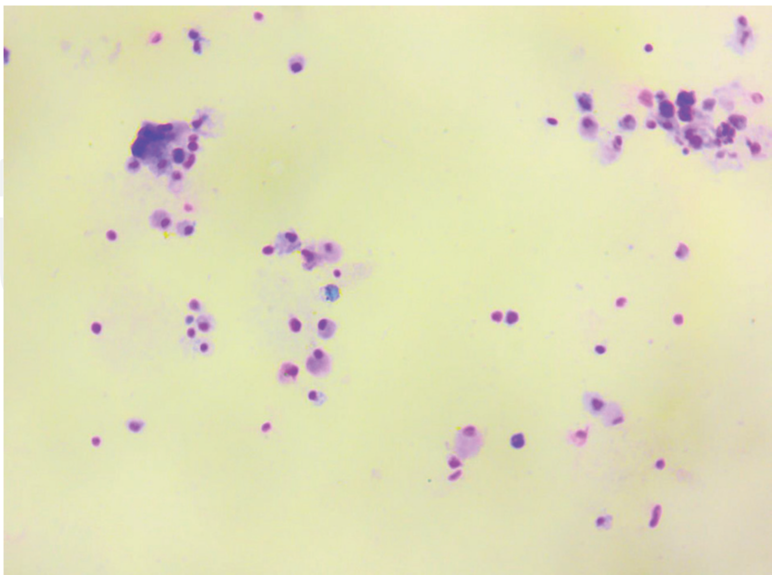

Figure 1. Polyphenotypic coelomocytes of a common earthworm *Metaphire posthuma* collected from a paddy field of India.

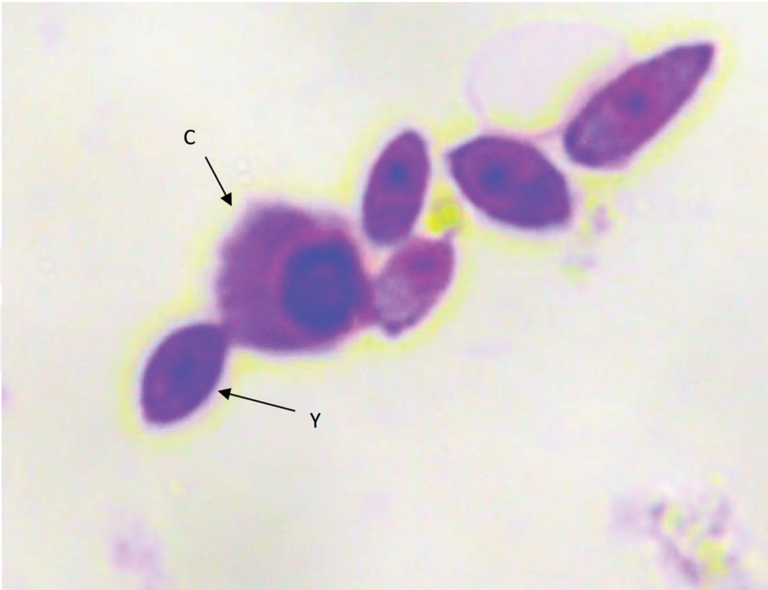

Figure 2. Formation of 'pagocytic cup' in a coelomocyte (C) of earthworm during engulfment of cultured yeast (Y). Phagocytosis is an established innate immunological response of coelomocytes against foreign particulates and toxins.

analyses of copper nanoparticle. Principal innate immune parameters like total coelomocyte (**Figure 1**) count, phagocytic response (**Figure 2**), oxidative stress were studied in earthworm exposed to environmentally realistic concentrations of sulphate and nanoparticles of copper. An undesirable shift in immune associated parameters indicated toxin induced immunological stress in earthworm. Unrestricted contamination of soil by emerging toxins like nanotoxins may thus result in prolonged immunological stress leading to population decline of these worms in agricultural soil.

Author details

Sajal Ray

Address all correspondence to: raysnailmail@rediffmail.com

Department of Zoology, University of Calcutta, India

References

[1] Bertrand M, Barot S, Blouin M, Whalen J, de Oliveira T, Roger-estrade J. Earthworm services for cropping systems. A review. Agronomy for Sustainable Development. 2015;**35**:553-567

[2] Ojha RB, Devkota D. Earthworms: 'Soil and Ecosystem Engineers' – A Review. World Journal of Agricultural Research. 2014;**2**(6):257-260

[3] Singh S, Singh J, Pal A. Earthworm as ecological engineers to change the physico-chemical properties of soil: Soil vs vermicast. Ecological Engineering. 2016;**90**:1-5

[4] Tersic T, Gosar M. Comparison of elemental contents in earthworm cast and soil from a mercury contaminated site (Idrija area, Slovenia). Science of Total Environment. 2012;**430**:28-33

[5] Gautam A, Ray A, Mukherjee S, Das S, Pal K, Das S, Karmakar P, Ray M, Ray S. Immunotoxicity of copper nanoparticle and copper sulfate in a common Indian earthworm. Ecotoxicology and Environmental Safety. 2018;**148**:620-631