
Identification of earthworm for sustainable agriculture – a review

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Abstract: Earthworms are considered as a friend of farmers. These fretful worms improve the air and water content in the dirt. When a worm dies, it decomposes into nitrogen and benefits the farmers. Nowadays, they are common prey for chemical contamination. Also, the agricultural farming today uses high quantity of pesticides to protect the crops from pest and diseases. By spraying pesticides, the lifecycle of earthworm is affected. This paper focuses on detailed study of earthworm and its importance on farming. It also deals with impact of chemicals on earthworm and its side effects. This paper discusses about the identification of earthworm in farmland and various methods for enhancing the growth of worms. This paper also focuses on the detailed description of various extraction methodologies of earthworms from the farms and gives the detailed analysis of merits and demerits of each extraction methods.

Keywords: earthworm; earthworm identification; fertility of soil; pesticides.

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1 Introduction

Charles Darwin, the Naturalist in 1881 published a book on *The Formation of Vegetable Mould through the Action of Worms with Observations on their Habitats* (Darwin, 1898), the composition portrays the essentialness of night crawler as far as pedogenesis, soil skyline, enduring movement and soil improvements. The strategies by that earthworm have a consequence on plant growth embrace direct effects like root feeding and transposal of plant seeds (Scheu, 2003). Zhang et al. (2013) explained about the rape seed yield and colza oil production improved with the role of earthworms.

Mainoo et al. (2008) provide the outline of vermicomposting as an economical procedure of treating organic wastes. This gained quality to waste rectification, animal feed super molecule production and plant food (Mainoo et al., 2008). Qiao and Ren (2014) used so much higher than the ground- excellence earthworm super molecule feedstuff and cost-effective and stable performance bio-fertiliser is also gaining all the means through culturing earthworm in agitated biological waste.

In 2000, Sanxing village dump founded associate degree earth worm yield a look at mostly within the Aidian District, Beijing, from that point forward, the world worm vandalise ejection in China begin to be modernised. In 2002, with the steerage of academician Sun Zhenjun from Chinese Agricultural University, Fengrun Tianlong night crawlers Development Co., Ltd. in space pushed China's first crawler bioreactor with progress. A customary earthworm reactor will accommodate six innumerable organic wastes daily, whereas producing 4.5 tonnes innumerable bioorganic chemical (Luo and Ma, 2011).

Though the earthworm has various advantages they are harmed by various chemicals used in farming. This leads to make the soil infertile. Triazole pesticides are exceedingly vigorous, low scum and wide-ranging chemical that are in the main used for customary mildew, rust illness, etc. The triazole pesticides reduced the night crawlers all through a portion subordinate way (Gao et al., 2010).

These earthworms can also safeguard the soils from oil spills. Advanced strength of soil bioremediation will be attained by the preface of earthworms into polluted soil (Chachina et al., 2016). Few species of earthworm are also used in the preparation of medicine which has been treated for diseases such as thrombosis and fever. There are many applications of earthworm. These tireless creatures make the soil and crops healthy.

This study reveals the importance of earthworm and its identification. The identification of earthworm helps in safeguarding the earthworm population present in

the soil. In agriculture, tillage of soil has adverse effect on earthworm population. The application of chemicals for farming kills these useful species. This study will be useful in protecting the earthworm.

2 Identification of earthworm

Arsenic contamination in soil creates toxins which affect animals and plants (Ng et al., 2003; Pendergrass and Butcher, 2006) The significant and synthetic biochemical possessions of the soil has been customised with the impact of metal contamination, additionally affects the microbes present within the soil (Pères et al., 2011) Metal contamination also affects the earthworm present in the soil, thus changes the earthworm activity (Romero-Freire et al., 2015). Arsenic in soil causes mortality (Langdon et al., 2001), makes inactiveness (Langdon et al., 1999) in earthworm.

An overview said that the event of night crawlers in agro environments coordinated to a 25% ascent in crop yield and a 23% lift in above inclination in the characteristic issue (Van Groenigen et al., 2014). The presence of night crawler rises the dirt richness and in this manner expands the yields. Therefore, it is a must to protect the earthworms from the above-mentioned contaminations. There are different methodologies which are followed for the identification of earthworm from the soil. Few feasible methodologies are given in Table 1 gives the detailed explanation of different extraction method for identifying the earthworm. There are various types of earthworm each one will be utilised for the specific use. The earthworm species and its identification methodologies can be explained with merits and demerits which is given in Table 1. Among all the methods hand sorting is the convenient and traditional method which is being followed for years. Formalin extraction is also a method used for the identification and extraction of earthworms.

Reliable and non-destructive withdrawal ways are necessary for the analysis and knowing the composition of oligochaete worm. Close to infrared spectrographic analysis is employed to spot the special footprints exhibit by varied oligochaete worm that lays burrows on the soil (Zangerlé et al., 2016).

Burrows accumulated from the area were known by examination their NIR unearthly highlights to the one of a kind highlights of macroaggregates made by the indistinguishable oligochaete worm species living inside a similar soil in lab conditions (Zangerlé et al., 2016).

Worms can be grouped and distinguished dependent on different various highlights. These contain their morphological, physiological, phylogenetic structures just as their environmental and social qualities (Ansari and Saywack, 2011).

The earthworms are collected by digging the soil. Proper care should be taken in order to avoid killing and damaging the earthworm. Three kinds of earthworm collection methods are adopted for the identification of earthworm's from the soil. Formal was progressively skilled for social occasion A. cortices, found in a lot higher plenitude. Bigger hand arranged examples were increasingly effective for catching Gloss scolex species. Stone monuments satisfactorily gathered soil staying Gloss scolex species (Baretta et al., 2007).

Table 1 Earthworm identification methodologies

<i>S. no.</i>	<i>Removal method</i>	<i>Earthworm species</i>	<i>Advantages/disadvantages</i>
1	Hand picking technologist (Singh et al., 2016)	Lumbricuscastaneus, Lumbricusrubellus, Lumbricusterrestris	This scheme illustrations best outcomes for worms a smaller amount more than 0.2 g living weight.
2	Formalin technique (Singh et al., 2016)	Lumbricusterrestris, Lumbricusrubellus, Diplocardia species	This methodology has antiseptic and antifungal belongings and conjointly poisons the underground water.
3	Octet scheme (Singh et al., 2016)	Eiseniaanderi.	Efficiency of this method furthermore be contingent on class, moistness, and water content of soil.
4	Mustard method (Singh et al., 2016)	Octolasiontyrtaeum	Potassium permanganate and additional definite than formol in an exceedingly park-like piece of ground (Ng et al., 2003).
5	Onion method (Singh et al., 2016)	Lumbricuspolypeus, Lumbricusrubellus	Little toxic to the worms and environment.
6	Spade test	Anecic earthworms	The tremor made by the creating by removal and taking the spade sample might chase some earthworms to remote areas, wherever they will now not be reached. This approach might thus cause a lower or a lot of variable numbers.
7	Garlic mustard (Stinson et al., 2018)	Lumbricusterrestris, Lumbricusrubellus and Dendrobaena species	Graphic patterns demonstrating night crawlers in light of the fact that the principle driver of vegetation alteration inside the nearness of non-local plants (Langdon et al., 1999).
8	Chilli extract (Sandor et al., 2015)	Aporrectodeacaliginosa juveniles	Advantages as compared through phytotoxic result of formol that exemplify cheapness, equipped convenience, and ease of application.

Combined extraction technique with hand-sorting of the definite soil volume and successive formalin sampling has done in the excavated holes. The advantage of this combined method is that the sampling efficiency is the higher and that species of different life forms and ecological groups are extracted (i.e., anecic, endogeic and epigeic species) (*Eurofins Environmental Testing*, <http://www.erofins.com/media/312800/61-earthworm-field-studies.pdf>). The alternative for this technique is suggested for collection of earthworms using onion extracts. Usage of onion extracts are high efficiency, low cost and non-toxic technique (Steffen et al., 2013). The earthworms can also be identified with maiden count. Deep burrowing earthworms forms piles, these piles are called as middens. Usually only one deep burrowing earthworm lives in each burrow

hole, therefore counting the middens can give a good estimate of the number of earthworms in an area.

In few areas, image processing is used as a tool for identifying earthworms but this method is not feasible since with a single captured photo it is very difficult to analyse each and every feature of the earthworm. Moreover, it is tough to judge the species of the earthworm with the captured snap of earthworm infestation (Nygqvist, 2011).

Nowadays, there are many techniques available for the identification of earthworm. The mostly followed methods are hand sorting and formalin method. The earthworms are collected from different environment and kept it in the lab for further analysis. Unique technique has been handled for identifying each species of earthworm.

The identification of earthworm is essential not only for producing organic matter for vegetation but also for making medicine for treating respiratory problems, irregular heartbeats, lowering blood pressure, etc. Table 2 gives the information about the disease cured by earthworms. The various disease and its remedies are given with the references. The bleeding gums can be cured by the ashes of the earthworm which is obtained by heating earthworm. It also helps to invigorate the weakness in women. Though they're not herbs, they are even so an important part of Chinese drugs. Wiggler is related to the bladder, liver, lung, and spleen and includes salty and cold properties.

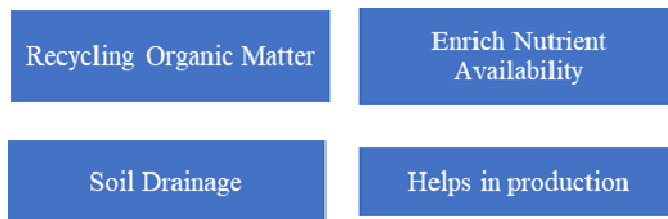
Table 2 Disease cured by earthworms

<i>Disease</i>	<i>Process to cure</i>
Bleeding gums	The ashes finished by heating earthworms in the hot pot are used for giving bleeding gums. These remains are utilised as tooth powder and to support satisfactoriness when consolidate with broiled tamarind seeds and betel nuts (Cooper et al., 2012).
Postpartum weakness in women	Night crawlers are first risen in water with salt and onions. The resultant clear fluid is poured and mixed in with the patient's sustenance (Cooper et al., 2012).

The earthworms are burned in the pots and the ashes are used for treating the disease called pyorrhoea which is practised in Burma. The roasted worms are powdered, then it is mixed with coconut oil to treat mortality. The ashes of earthworm is having sufficient nourishment for hair which improves the hair growth when it is mixed with the oil and by gentle compress on scalp by applying this oil. The lipids in the earthworms can be used by the biochemist for treating various disease. The small pox disease is also cured by consuming the water boiled with earthworm. Human lactation can be increased by the consumption of earthworm boiled water.

3 Earth worm in soil fertility

Earthworm feeds on the dead and organic matter; it increases the soil penetrability, also influence ion transport in soils (Syers and Springer, 2013). The root distribution of the plant and microbial activity of the crops has been increased by the burrowing of the soil by earthworms. The major benefits of earthworm for soil is shown in the below Figure 1.

Figure 1 Benefits of earthworm to soil (see online version for colours)

The earthworms improves the soil nutrients. It makes the debris as the feed and nourishes the nutrients thereby improves the soil quality. It makes the soil molecules more stable. Nitrogen in the castes of the earthworm can be consumed directly to the plants. It also plays a main role in drainage the soil by aerating properly the soil.

3.1 *Recycling organic matter*

Earthworm with bacteria and fungi decomposes the organic matter. Breaking down waste and plant litter and planning 2–20 tons of common issue per hectare consistently, and reusing leaf litter under estates and in other forested domains.

3.2 *Enrich nutrient availability*

Earthworm feeds on dead leaves, week roots and other organic matter from soil. They digest these materials and reintroduce these materials in the dirt as standing. When they die, it is decomposed into nitrogen which adds nutrients to the soil.

3.3 *Soil drainage*

The burrowing of worms progresses the physical party of the dirt, conveying channels through which plant roots may much more effectively attack the earth. Regardless of expanding soil porosity and wind stream, this action moreover improves soil waste and water entrance while disposing of hardan conditions (Zhang et al., 2013).

3.4 *Helps in production*

Assessment of night crawlers in New Zealand and Tasmania start worms adjusted to sans worm suffering fields shaped a hidden augmentation of 70%–80% in field improvement, with a long stretch 25% extension: this raised stock passing on limit.

Scientists and researchers are aware about the earthworm has vital role in farming and enhance the fertility of the soil. The chemical analysis has been done in the same land with two scenarios that is with earthworm and without earthworms. The land with earthworm shows drastic change in nitrogen content; phosphorous, convertible potassium, convertible calcium and carbon with increase in worm population (Syers and Springer, 2013).

Right now, the applying of synthetics has troublesome outcome on crawler and lessens the number of inhabitants in night crawlers. Night crawler's vermicompost is demonstrating to be amazingly wholesome natural manure and just development

advertiser over the definite fertilisers and a defensive homestead contribution against compound composts that has devastated the dirt things and decreased its common ripeness throughout the years (Sinha et al., 2009).

Earthworm also plays a vital role in waste management. Night crawlers can be utilised to discard a wide range of natural waste including sewage, creature excrement, squander paper mash, bottling works waste and mushroom fertiliser (Edwards, 1992). Vermicomposting by worms will occupy 60–70 antiquity squanders from landfills (Sinha et al., 2014). These days these oligochaete species are wide stricken by synthetic compounds. Worms are presented to synthetic substances in a sort of manners by which. When cultivable land is treated with pesticides to oversee soil-possessing irritations, the synthetic concoctions are applied to deal with the gadfly and sicknesses in crops (Edwards, 1992).

It is also affected by fertiliser application fertiliser applications like anhydrous ammonia kills a rare worm in the narrow band and reduces the production and soil fertility. Greatest herbicides used in crop production should also toxic to worms but it is not too harm like fertilisers. Few insecticides are toxic to worms, it may also kill the worms, but their effects can be reduced by keeping the application band as narrow as possible. Wide-ranging, the organophosphate and pyrethroid insecticides are inoffensive to mildly toxic, whereas the carbamate insecticides and fungicides are extremely toxic. Nematicides in general are also highly toxic and affect the earthworm (Edwards, 1992).

Earthworm reduces the PH in the soil (Wang et al., 2019). The evolution of earthworm for taking the analysis about the role of earthworm can be explained (Yuan et al., 2019).

4 Conclusions

It is a well-known truth that the earthworms are the ecological engineers which is continuously working for moulding the soil and environment, thereby increasing the production and soil fertility. But these species are endemic and widely affected by toxins every day. The motto of this work is to protect the earthworm from these toxins with the identification methodologies suggested in this paper. It also gives the detailed description of role of earthworms in enhancing soil fertility. Further studies will be required to improve earthworm production and protection to safeguard the environment. The earthworms are rich in proteins and it have some special kind of enzymes to treat the various chronic diseases therefore more research has been conducted on earthworms to serve the medical society.

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