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Original Research Paper

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IMPACT OF EARTHWORM BIODIVERSITY IN SOIL FERTILITY BY VERMICOMPOSTING.

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ABSTRACT The biodiversity is responsible for the earthworms are the biological indicator of the soil ecosystem as they indicate the health and fertility of the soil for proper cropping. In the soil for proper aeration, rich nutrient contents earthworms are very essential organisms. They enhance the nutrients contents, increase water holding capacity, and improve microbial activity in the soil. All over the world approximately 3627 species of earthworms are there. Earthworms are of two type's micrdrilli and megadrilli, in microdrilli group about 280 species, and the rest all are under megadrilli. Megadrilli group earthworms are soil living earthworms, they are grouped under three subgroups epigeic, endogeic, and anecic. Earthworms work for formers day- night without any charge and make the soil more nutritious and more aerated that helps in crop production. The major problem nowadays is to be recycled the organic waste into humus like products. For crop production enhancement organic manure is a better option instead of chemical fertilizer. Earthworms decompose the organic waste into organic manure. By the use of vermin techniques (use of earthworms and organic waste) in the presence of oxygen organic waste turns into manure. The diversity and number of the earthworms in the soil change the soil texture and improve nutrient contents.so it is called friends of farmer.

KEYWORDS :

INTRODUCTION

The burrowing habit of earthworms makes the soil more porous and creates a new way to proper aeration in the soil. Earthworms feed decaying organic waste and soil and excrete approximately 60 to 80% of their feed (Sinha *et al.*, 2002). Their role in soil fertility is very crucial as they make soil more air convener and discharge nutrients into the soil present in their feces. Earthworms are the "intestine of the earth" said by Aristotle they decompose the organic matter like plants leafs decaying fruits and soil also (Bhadauria and Sexana, 2010). The soil fertility increases with an increase in the nutrients, proper aeration, and water holding capacity, along with these factors microbial activities also have a huge impact on the soil. The fertility of the soil is directly proportional to the crop improvement (Rochester *et al.*, 2001). Earthworms are delivering natural services to human beings from ancient times to nowadays by providing worm manure (vermicast) and vermiwash which positively affects soil fertility and crop improvement. Earthworms are the friends of the farmer they plough the field without any cost. Earthworms work for farmer's day-night and improve crop productivity by making their field more nutritive by converting the decaying organic matter into humus-like products. Earthworms are soil ecosystem modifiers as they are improving the soil nutrient profiles (Jones *et al.*, 1994). General description and origin of earthworms Earthworms are soil worms that live in organic matter-rich soil. Earthworm feeds on surface decaying organic matter like plant leaf, fruit wastes, and other biodegradable wastes. They consume waste and convert it into humus-like products like vermicompost (manure). The ancestor of today's earthworms was originated approximately 600 million years ago and from the days of origin, they enhance the soil profile by making the soil more porous and secreting their mucus into the soil (*Sinha, 2009*). The first earthworm named by Linnaeus in 1758 that was Lumbricusterrestris. The next species of earthworm discovered was Eiseniafetida described by Cuvier (1824). Earthworms are found over the globe except in snowy and very hot regions because earthworms are very temperature sensitive however they have diverse habitats where nutrient-rich organic matter easily available like the garden, paddy fields, and places rich in moisture contents nearly 55 to 60% (Gupta *et al.*, 2016). The earthworms is long, with cylindrical elongated body, compressed at both the ends, the body of earthworms is covered with a soft thin pellicle. The pellicles of earthworms are transparent and temperature-sensitive. Body divided metamerically into 80 to 100 segments. Earthworms are hermaphrodite mean male and female reproductive organs found in single organisms. Sexual maturity attains at the age of 6 weeks. When environmental conditions favorable a pair of earthworms can produce more than 100 cocoons in 6 weeks to 6 months (Ismail, 1997). Systematics: Earthworms come under the phylum Annelida and belong to the group Oligochaeta.

Earthworms As Bioindicator Of Soil Fertility And Health

The earthworms are the biological indicator of the soil ecosystem as they indicate the health and fertility of the soil for proper cropping (Pulleman *et al.*, 2012). The number of earthworms in the soil determines the health of the soil and indicate the microorganisms like bacteria, fungi, viruses and other organisms in the soil, the high number of earthworm indicates the high biodiversity of the microorganisms in the soil (Lakzayi *et al.*, 2015). A prominent microbial community is present in a rich organic matter area as many organisms like bacteria, fungi are present there for decomposition vermicompost is high in organic nutrients (Hedlund, 2002). Bacterial community and fungal hyphae in association with plant, enhance the soil productivity (Artursson *et al.*, 2006; Nuccio *et al.*, 2013). The high microbial population of bacteria, fungi, actinomycetes, and the higher enzymatic activity seen in the soil where the population of earthworm is high an area having higher earthworm diversity also have a higher microbial diversity that helps in the crop yield production without the use of chemical fertilizers (Haynes *et al.*, 1999).

Role Of Earthworms In Crop Yield Quality

For a better and high yield of crop production and nutrients, rich organic production sustainable soil environment is necessary. Earthworms excrete various plant growth regulators in their mucus-like auxin and cytokinin (Krishnamoorthy and Vajranabhaiah, 1986). Earthworms play a key role in maintaining soil texture and balance soil ecosystem (Shuster *et al.*, 2000). The major macrofauna of soil is earthworms they enhance the soil texture and nutrient content by secreting mucus in the soil, convert the organic biodegradable matter into nutrient-rich humus like manure (vermicast) (Sharma and Garg, 2018). Earthworms improve soil fertility by changing the biochemical and physical properties of soil. Earthworm excretion by-product vermicast is rich sources of various inorganic and organic nutrients (Edward *et al.*, 1995; Kale, 1998; Lalitha *et al.*, 2000). Vermicast increases the inorganic salt concentration which is used by the plant root system. Soyabean and wheat production increase 51% and 47% respectively by the use of earthworms and their vermicast (Palanisamy, 1996). Vermicomposting positively modulates the functioning of organic nutrients in the soil, mucus present in the vermicastspeed up the primary breakdown of organic residue into the simpler compound which easily absorb by plants (Lavelle, 1988; Six *et al*., 1998; Kumar *et al*. 2019). Organic matter ingestion by earthworm from the soil, mixing them with gut mucus and convert them into humus (Jairajpuri, 1993). The feeding mechanism of earthworm function as a soil fertility enhancer because earthworms improve soil aeration, nutrient content and increase microbial activity (Hickman and Reid, 2008; Lemitiri *et al*., 2014; Medina *et al*., 2019). Earthworms burrowing and nutrient-rich mucus-secreting habit increase the soil profile by enhancing the physical, chemical, and microbial activity (Lin *et al*., 2016; Le Bayon *et al*., 2021). Organic matter in the gut contains a high level of nutrients and water as compared to nutrients and water present in the soil and these organic matters after digestion excrete out from the anus in the form of vermicast which is enriched with a high nutrient content that improves the soil ecosystem (Buck *et al*., 2000; Singh *et al*., 2016). In vermicast high nutrient content of N, P, K, and Ca is available which is easily absorbed by the plant root system and enhance the crop productivity (Bhadauria and Ramakrishnan, 1989).

Vermicompost Production

Vermitechnology is a scientific method in which we use epigeic (surface feeder) and endogeic (subsurface feeder) species of earthworm for the conversion of biowaste into the vermicast with the help of soil microorganisms. Vermicomposting is the process of the decomposing of the biodegradable organic waste with the use of worms and microorganisms into the vermicast which is nutrient-rich organic manure. By the use of earthworms, we decompose organic biodegradable waste into the manure (Gunadi *et al*., 1997) and minimize the waste impact on mankind. In 21st century rapid civilization, industrialization, and urbanization generate enormous waste from various sectors. In vermicomposting kitchen waste, institutional waste, paper waste, industrial waste, agricultural waste, and cow dung are used for earthworm feeding and earthworm convert these organic waste into manure. The role of earthworm in the formation of vermicompost from the biodegradable organic waste and improve fecundity of soil since 1881 by Darwin. The process of decomposition of waste into nutrient-rich manure was established by Kale *et al*. (1982) and Ismail (1993). Epigeic species of earthworms are extensively used in the vermicomposting like Eiseniafetida, Eudriluseugeniae, Eiseniaandrei, Perionyxexcavatus, and Lumbricusrubellus are the most commonly used species in vermicomposting. Endogeic and anecic species of earthworms are not good for vermicomposting because both the species are not surface decaying material feeders, they live inside the soil by making horizontal and vertical burrow respectively but both the species are very useful in nutrient recycling and nutrient mixing in the soil. For this reason, endogeic and anecic species of earthworms are used for the modification of soil texture. Application of vermicompost on the agricultural practices we can minimize the negative impact of chemical fertilizers on the crops. So by the use of vermicomposting we can easily decompose organic waste into nutrient rich organic manure. This technique convert the biodegradable waste into the humus like product without harming the environment .Compost obtain from the vermicomposting process is odorless, nutrient

CONCLUSION

Several studies conclude that the role of earthworm diversity to improve soil fertility and enhance crop productivity. Earthworms digest organic matter and convert them into the humus. Humus has a high value of inorganic salts like N, P, K, and Ca these are the main integrant that enhances the crop productivity. The earthworm found in the different layer of the soil like epigeic earthworm found in the upper layer of the soil and not built the permanent burrow so this species is not involved in the mixing nutrients and aeration in the soil but the composting process is very fast as it decomposes biodegradable organic matter into the nutrient-rich manure. Vermicast or earthworm manure changes the soil profile, texture, and stabilization of the microbial community in the soil. Endogeic earthworms live in the horizontal burrow and feed on soil and some plant litter and help in the mixing of nutrients in the soil and change the texture of the soil. Anecic earthworms live in the deeper parts of the soil by making a vertical burrow. The decomposition efficiency of organic waste of anecic earthworms is very low but this species eat organic wastes like plants litters, leaves, decaying organic wastes on the soil surface. For feeding they come out their burrows at night and feed then returns to their burrows. They excrete their droppings in their burrows and changes texture, aeration, nutrient content in the soil. So the impact of the earthworm biodiversity on soil fertility and cropyeild quality is very important.

REFERENCES:-

1. Artursson, V., Finlay, R.D. and Jansson, J.K. (2006). Interactions between arbuscular mycorrhizal fungi and bacteria and their potential for stimulating plant growth. Environmental Microbiology, 8(1): 1-10
2. Bhadauria, T. and Ramakrishnan, P.S. (1989). Earthworm population dynamics and contribution to nutrient cycling during cropping and fallow phases of shifting agriculture (Jhum) in north-east India. Journal of Applied Ecology, S1: 505-520.
3. Bhadauria, T. and Saxena, K.G. (2010). Role of earthworms in soil fertility maintenance through the production of biogenic structures. Applied and Environmental Soil Science, 1-10.
4. Buck, C., Langmaack, M. and Schrader, S. (2000). Influence of mulch and soil compaction on earthworm cast properties. Applied Soil Ecology, 14(3): 223-229.
5. Cuvier, G. (1824). Analyse des travaux de l'Académie royale des sciences, pendant l'année 1824. imprimerie de Firmin Didot
6. Edwards, C.A., Bohlen, P.J., Linden, D.R. and Subler, S. (1995). Earthworms in agroecosystems. In: Earthworm Ecology and Biogeography in North America. (Hendrix, P. F. eds.), Lewis Publisher, Boca Raton, FL, pp. 185-213.
7. Gupta, K.K., Aneja, K.R. and Rana, D. (2016). Current status of cow dung as a bioresource for sustainable development. Bioresources and Bioprocessing, 3(1): 1-11.
8. Haynes, R.J., Fraser, P.M., Tregutha, R.J., Piercy, J.E., Diaz-Cosin, D.J., Jesus, J.B., Trigo, D. and Garvin, M.H. (1999). Size and the activity of the microbial biomass and N, S, and P availability in earthworm casts derived from arable and pastoral soil amended with plant residues. 6th International Symposium on Earthworm Ecology. Vigo, Spain. Pedobiologia, pp. 43: 568-573.
9. Hedlund, K. (2002). Soil microbial community structure in relation to vegetation management on former agricultural land. Soil Biology and Biochemistry, 34(9): 1299-1307.
10. Hickman, Z.A. and Reid, B.J. (2008). Earthworm assisted bioremediation of organic contaminants. Environment International, 34(7): 1072-1081.
11. Ismail, A. (1997). Vermicology: the biology of earthworms. Orient Longman. pp. 23-40.
12. Ismail, S.A. (1993). Keynote papers and extended abstracts. In Congress on traditional sciences and technologies of India, IIT, Mumbai, Vol. 10, pp. 27-30.
13. Ismail, S.A. (1993). Keynote papers and extended abstracts. In Congress on traditional sciences and technologies of India, IIT, Mumbai, Vol. 10, pp. 27-30.
14. Jairajpuri, M.S. (1993). Earthworms and vermiculture: an introduction. In: Earthworm resources and vermiculture, pp. 1-5
15. Jones, C.G., Lawton, J.H. and Shachak, M. (1994). Organisms as ecosystem engineers. In Ecosystem management. Springer, New York, NY, pp. 130-147.
16. Kale, R.D. (1998). Earthworm Cinderella of Organic Farming. Prism Book Pvt Ltd, Bangalore, India. pp. 88.
17. Kale, R.D., RD, K. and Bano, K. (1982). Potential of Perionyx excavatus for utilizing organic wastes. International Journal of Recycling of Organic Waste in Agriculture, 5: 65–86
18. Krishnamoorthy, R.V. and Vajranabhaiah, S.N. (1986). Biological activity of earthworm casts an assessment of plant growth promotor levels in the casts. Proceedings: Animal Sciences, 95(3): 341-351.
19. Kumar, V., Kumar, P. and Singh, J. (2019). An introduction to contaminants in agriculture and environment. In: Contaminants in Agriculture and Environment: Health Risks and Remediation, 1: 1-8.
20. Lakzayi, M., Moradi, H., Sabbagh, E. and Rigi, K. (2015). Effect of vermicomposting on microbial biomass in contaminated soil by heavy metals. Journal of Biodiversity and Environmental Sciences, 6(1): 85-101.
21. Lalitha, R., Fathima, K. and Ismail, S.A. (2000). Impact of biopesticides and microbial fertilizers on productivity and growth of Abelmoschus esculentus. Vasundhara. The Earth. 1&2: 4-9
22. Lavelle, P. (1988). Earthworm activities and the soil system. Biology and Fertility of Soils, 6(3): 237-251
23. Le Bayon, R.C., Bullinger, G., Schomburg, A., Turberg, P., Brunner, P., Schlaepfer, R. and Guenat, C. (2021). Earthworms, plants, and soils. Hydrogeology, Chemical Weathering, and Soil Formation, 81-103
24. Lemtiri, A., Colinet, G., Alabi, T., Cluzeau, D., Zirbes, L., Haubruge, É. and Francis, F. (2014). Impacts of earthworms on soil components and dynamics. A review. Biotechnologie, Agronomie, Société et Environnement, S3:1-18.
25. Lin, Z., Zhen, Z., Wu, Z., Yang, J., Zhong, L., Hu, H. and Zhang, D. (2016). The impact on the soil microbial community and enzyme activity of two earthworm species during the bioremediation of pentachlorophenol-contaminated soils. Journal of Hazardous Materials, 301: 35-45
26. Medina-Sauza, R.M., Álvarez-Jiménez, M., Delhal, A., Reverchon, F., Blouin, M., Guerrero-Analco, J.A. and Barois, I. (2019). Earthworms building up soil

microbiota, a review. Frontiers in Environmental Science, 7: 81-90
27. Nuccio, E.E., Hodge, A., Pett-Ridge, J., Herman, D.J., Weber, P.K. and Firestone, M.K. (2013). An arbuscular mycorrhizal fungus significantly modifies the soil bacterial community and nitrogen cycling during litter decomposition. Environmental Microbiology, 15(6): 1870-1881.
28. Palaniswamy S. (1996). Earthworm and Plant Interactions. Paper presented in ICAR Training Program; Tamil Nadu Agricultural University, Coimbatore.
29. Pulleman, M., Creamer, R., Hamer, U., Helder, J., Pelosi, C., Peres, G. and Rutgers, M. (2012). Soil biodiversity, biological indicators, and soil ecosystem services—an overview of European approaches. Current Opinion in Environmental Sustainability, 4(5): 529-538.
30. Rochester, I.J., Peoples, M.B., Hulugalle, N.R., Gault, R. and Constable, G.A. (2001). Using legumes to enhance nitrogen fertility and improve soil condition in cotton cropping systems. Field Crops Research, 70(1): 27-41.
31. Sangwan, P., Kaushik, C.P. and Garg, V.K. (2008) Feasibility of utilization of horse dung spiked filter cake in vermicomposters using exotic earthworm Eisenia foetida. Bioresource Technology, 99: 2442–2448.
32. Sharma, K. and Garg, V.K. (2018). Solid-state fermentation for vermicomposting: a step toward sustainable and healthy soil. In Current Developments in Biotechnology and Bioengineering, Elsevier. pp. 373-413.
33. Shuster, W.D., Subler, S. and McCoy, E.L. (2000). Foraging by deep-burrowing earthworms degrades the surface soil structure of a fluventic Hapludoll in Ohio. Soil and Tillage Research, 54(3-4): 179-189.
34. Singh, S., Singh, J. and Vig, A.P. (2016). Earthworm as ecological engineers to change the Physico-chemical properties of soil: soil vs vermicast. Ecological Engineering, 90: 1-5.
35. Sinha, R.K. (2009). Earthworms: the miracle of nature (Charles Darwin's 'unheralded soldiers of mankind & farmer's friends').
36. Sinha, R.K., Herat, S., Agarwal, S., Asadi, R. and Carretero, E. (2002). Vermiculture and waste management: the study of the action of earthworms Eisenia foetida, Eudrilus euginae, and Perionyx excavatus on biodegradation of some community wastes in India and Australia. Environmentalist, 22(3): 261-268.
37. Six, J., Elliott, E.T., Paustian, K. and Doran, J. W. (1998). Aggregation and soil organic matter accumulation in cultivated and native grassland soils. Soil Science Society of America Journal, 62(5): 1367-1377.