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Efficacy and significance of verrmicompost in modern Agriculture to protect soil against the destructive chemical fertilizer under climate change scenario

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Abstract

Changing climate undermines global food security by adversely affecting crop production. Biological agriculture, or organic farming, serves as an alternative to traditional methods that depend heavily on synthetic inputs. Earthworms are found almost all over the world, being absent only from regions where soil is sandy and deficient in humus. They are also not found in mountain regions with scanty and poor soil. They also do not prefer very clayey/acidic soils. They live usually in the upper layers of slightly damp soil, lawns and gardens, upto the depth of 12 to 18 feet in burrows for protection against the enemies and unfavorable conditions of climate. Vermicomposting is the term given to the process of conversion of biodegradable matter by earthworms into vermicast. Earthworms are nocturnal creatures, lying in their burrows during the day, but coming out at night promoted by hunger and love. They feed on dead leaves and other organic material. Vermicompost is proving to be highly nutritive organic fertilizer and more powerful growth promoter over the conventional composts against the destructive chemical fertilizers which destroyed the soil properties and natural fertility over the years. This compost is rich in NKP (nitrogen 2-3%, potassium 1.85-2.25% and phosphorus 1.55-2.25%), micronutrients, beneficial soil microbes and also contain plant growth hormones & enzymes. It is scientifically proving as miracle growth promoter and plant protector from pests and diseases. *The study explained the ecology of earthworm and the important contribution and roles placed by the earthworm in Rahim Yar Khan ecosystem.*

Keywords*: Earthworm, vermicomposting, fertilizer*

Introduction

Intensive agriculture, driven by the application of inorganic fertilizers, has boosted crop yields but it destroys our soil and environmental health (Wang et al., 2017). The increasing use of chemical fertilizers day by dy leads to rapid decomposition of soil organic matter, deteriorating soil structure and diminishing fertilizer use efficiency through nutrient fixation and leaching (Han et al., 2020). Organic farming that leads to a cost-effective, environmentally friendly approach to improving soil fertility and sustainability offering high yields (Ganeshnauth et al., 2018). Somehow, traditional organic fertilizers like animal manure and plant residues often fall short in meeting crop nutrient requirements due to their limited nutrient availability and high labor (Degwale, 2016). Among organic fertilizers, vermicompost stands out for its potential to significantly increase crop growth (Wang et al., 2010). Vermicomposting is a cost-effective, eco-friendly, and sustainable technique for converting large amounts of organic waste into a high-quality organic fertilizer with controlled bio-oxidation (Kamatchi et al., 2018 and Abou el-Goud et al., 2021). Vermicomposting is the term given to the process of conversion of biodegradable matter by earthworms into vermicast, i.e believed to contain hormones and enzymes which it acquires during the passage of the organic matter through the earthworm gut. The vermicast is believed to be very good organic fertilizer and soil conditioner. Earthworms are invertebrates belonging to the phylum Annelida and class Oligochaeta. They make their burrows partly by boring with their pointed anterior ends and partly by swallowing the earth. Earthworms possess both male and female gonads. In damp weather, often with mouth or anus protruding from the burrow, while during dry weather, they burrow to several feet underground, coil up and become dormant (Abbasi and

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Ramasamy 2001). These are great benefactors of soil and agriculture (Satchell, 1983). Earthworms continuously till and aerate the soil, supply it with organic matter, and help moisture (Bhawalkar, 1996). In last year's earthworms have been increasingly employed in vermicomposting biodegradable solid wastes (Abbasi and Ramasamy 2001, Bhawalkar, 1993 and Gajalakshmi and Abbasi 2003). It was the first distinguish surface living smaller worms with high metabolic rate from deep dwelling larger worms (Byzova, 1965). Ecological classification of earthworms divided into 3 generalised life forms i.e (i) epigeics, (ii) anecics and (iii) endogeics as described by (Bouche, 1977). Epigeics are the species that live above the mineral soil surface (Lee,1985). They are phytophagous and generally have no effect on the soil structure as they cannot dig into the soil (Ismail, 1997). They are small in size with uniform colouration. Anecics are the species that live in burrows in mineral soil layers, but come to the surface to feed on dead leaves, which they drag into their burrows. They construct vertical tunnels (Kumar, 1994). Endogeics are the species that inhabit mineral soil horizons feeding on soil more or less enriched with organic matter (Lee, 1985). *Vermicompost is rich in NKP (nitrogen 2-3%, potassium 1.85-2.25% and phosphorus 1.55-2.25%), micronutrients, and beneficial soil microbes.* They do not feed to any great extent on the leaf material in situ, but first pull it into the mouth of the burrow, to a depth of 2.5-7.5 cm, so forming a plug, which may protrude from the burrow. After passing through the animal, the food emerges as a compact, concentrated mass termed as casting (Edwards and Lofty 1972). The rapid urbanization, industrial activities, and other anthropogenic actions have led to significant soil pollution, posing serious concerns for human health and the environment (Liu et al., 2011). The Soil contamination now a days arises from various pollutants, including heavy metals, pesticides, and chemical fertilizers (Shang et al., 2013). That contaminants stunt plant growth, disrupt microbial activity, and can indirectly harm human health (Lian et al., 2020). Present day agriculture faces significant challenges from abiotic stresses such as salinity, drought, and extreme temperatures. These problems are exacerbated by factors like climate change, land degradation, and urbanization (Kujur et al., 2022). Abiotic stress often depletes soil nutrients, leading to reduces plant growth and lower yields, which can adversely affect economic returns for the better development of a growing country (Chinsamy et al., 2014).

The present study was designed to assess the efficacy and significance of verrmicompost in modern Agriculture to protect soil against the destructive chemical fertilizer under climate change scenario.

Materials and Methods

Earthworms were collected from the local market of Rahim Year khan district. They were acclimatized for 3 days to the prevailing soil conditions under normal day / night light. The worms having approximately equal size (12 x 0.5cm) and weight 0.5 x 0.7 g) were selected. The bedding is placed first, then inoculated with worms, and then covered repeatedly with thin (less than 10 cm) layers of food. The worms consume the food at the food-bedding interface, then drop their castings near the bottom of the windrow. Layers of new bedding should be added periodically to replace the bedding material gradually consumed by the worms. Some earthworms can burrow very deep into the soil. Most shallow working species, which are usually smaller, do not have well defined burrows. This was done in the vicinity of Director Agriculture (Farms, training and AR) office Rahim Yar Khan District. It lies in the southern part of Pakistan between 160110 – 170450N latitudes and 760030 – 770300E longitudes, with a geographical area of 16,174 sq km. The soil in which earthworm lives *rich with NKP (nitrogen, potassium and phosphorus, micronutrients, and other beneficial soil microbes) which is called vermicast. Then this soil sieved from a special machine called worm compositing sieving machine. Then this soil filled in bags and these bags spread in the field of crops and other garden and tunnel vegetables premises which produces better yield then before.*

Results and discussions

Vermireactors which are essentially big damp soil square shape in which earthworms are made to feed upon animal manure or other biodegradable solid wastes, do not require continuous inputs of other forms of energy for their operation. As such, the cost of the square soil constitutes the major component of cost input in a vermireactor. Which is shaded with green cloth in order to maximise benefit from such reactors, it is essential to minimize the reactor volume for a given vermicast output Gajala kshmi, et.,al. (2001). Factors Influencing Culturing of Earthworms Several factors control the culturing and maintenance of healthy earthworm populations in which the most important are: i) Food; ii) Moisture; iii) Temperature; iv) Light; v) pH and vi) Protection from predators. Food is one of the most important factors that control the establishment and continuity of earthworm populations. Higher nitrogen ratios help in faster growth and greater production of cocoons. Fresh green matter is not easily fed upon. Decomposition by microbial activity is essential before earthworms can feed on fresh waste. Moisture levels have to be maintained at around 50% so that the microbial activity is high and the food matter is easy to feed upon. Excess water leads to anaerobic conditions, which in turn lowers the pH and creates acidic conditions. Temperature affects metabolism, growth and reproduction. Soils exposed to the sun lose moisture quickly and are usually devoid of earthworms. Earthworms maintain lower body temperatures than the surrounding soil or organic matter by their metabolic adjustments. They are very sensitive to light. The photoreceptor cells detect light and the earthworms moves away to avoid strong light. The deep burrowing anecics and other species emerge at the surface only at night for this reason. They are sensitive to changes in pH. They prefer conditions of neutral reaction. Earthworms find it difficult to survive if the pH falls below 6 and thus they migrate or are killed. They are preyed upon by many species of ants, birds, toads, salamanders, snakes, moles, cats, rats, dogs, etc. A variety of invertebrates also feed on earthworms. These include flatworms, centipedes, staphylinid

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beetles, etc. Vermicomposting is a biological process that transforms non-toxic organic waste into nutrient-rich compost. Earthworms play a crucial role in this process, converting biowaste into high-quality manure within 60–90 days under aerobic conditions (Garg and Gupta, 2011). Epigeic species are particularly effective for managing biosolid waste, producing high-quality compost at a faster rate (Singh et al., 2017). Biotic stress refers to conditions where a plant's growth is hindered by interactions with microbes (fungi, bacteria, viruses), insect pests, or weed infestations (Pantazi et al., 2020; Sapre et al., 2021). Natural products like vermicompost contain diverse metabolites and bioactive. Vermicompost vs. inorganic fertilizers optimal plant growth and development are essential for achieving high yields (Theunissen et al., 2010). These processes are regulated by natural plant growth hormones. While synthetic growth regulators can be used, they are not economically viable and contribute to environmental pollution with low biodegradability. Bio fertilizers such as vermicompost effectively address field cropping challenges, enhancing growth and productivity by improving soil's physical and biochemical properties. Benefits include improvement in the water retention capability of the soil, and better plant availability of the nutrients in the vermicasts compared to the 'parent' (pre-vermicomposted) materialIsmail, (1998) and Curry and Byrne (1992). The magnitude of the transformation of phosphorus forms was found to be considerably higher in the case of earthworm-inoculated organic wastes, showing that vermicomposting may prove to an efficient technology for providing better phosphorus nutrition from different organic wastes Reinecke, et.,al (1992) and Ghosh, et.,al.(1999). Studies carried out by Basker et.,al. (1993) under field conditions results that the castings of earthworms contained two to three times more available potassium than the surrounding soil. Earthworm castings have a higher ammonium concentration and water-holding capacity than the normal soil. This cast are believed to contain enzymes and hormones that stimulate plant growth and discourage pathogens as described by Ismail, (1997), Abbasi and Ramasamy (1999) and Szczeck (1999).

Benefits of Vermicompost

1) **In Soil**

- Improving the soil texture, improving aeration, and helping plant roots depth.
- Increasing the soil water retention capacity of soil.
- Enriches soil with micro-organisms.
- Microbial activity in worm castings is 10 to 20 times more.
- Improves water holding capacity.
- The worm castings are rich in humic acids, which helps in pH control
- Improves nutrient recycling in soil.

2) **Plant Growth**

- Enhances germination, plant growth, and yield of plant which grow in it.
- Improves root growth and structure of the plants.
- Enriches soil with microbial biomass.

3) **Nutrients**

- Provides plants with essential nutrients and aids in the suppression of plant diseases.
- Worm castings contain five times more nitrogen, seven times more phosphorus and eleven times more potassium than ordinary soil.

Conclusions

It is concluded that in our cultivated areas especially for field crops, vegetables and garden crops if we developed a small piece of land for vermipocasting then we will get better utilization of our land to obtain maximum yield. It is an important alternative source of fertilizer as compared to inorganic fertilizers naturally. An alternative method for waste management through which vermicompost produced with relatively high nutrient content than compost and manures. So we shifted ourselves from chemical fertilizers to reduce the hazardous effect of chemicals to both crop and human being. Application of vermicompost either alone or in combination with fertilizers promotes crop yield. It is the best solution to face immediate problem of declining soil fertility and for production of food thus is the best means of abating pollution, soil degradation and discriminate use of chemical fertilizers. Its application could be a better option and farmers need to be educated about the importance of vermicompost.

VERMICOMPOST GLIMPSE DURING THE STUDY

Shed for the earthworm multiplication

Organic fertilizer from vermicast

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Texture of treated soil

Bags ready for fields

References

1. Abbasi S A & Ramasamy E V. (1999). Anaerobic digestion of high solid waste, in Proc Eighth Nat Symp Environment (IGCAR, Kalpakkam, India) 220-224.
2. Abbasi S A & Ramasamy E V. (2001). Solid waste management with earthworms (Discovery Publishing House, New Delhi) 1-178.
3. Abou El-Goud, A.R.; Al-Masood, Fahd, R.; Elzopy, Karam A., Mona M. Yousry**.** (2021)**.** Performance Potato Cultivars in an Organic Farming System using Organic Fertilizers, Vermicompost and Azolla", Australian J. of Crop Science, 15(07), pp. 1081-1088, ISSN: 1835-2707, ESSN, 1835-2693.
4. Basker A, Macgregor A N & Kirman J H, (1993). Exchangeable potassium and other cations in non-ingested soil and cast of two species of pasture earthworms, Soil Biol Biochem, 251673-1677.
5. Bhawalkar U S, Bioconversion of organic residues, (1996). Ph D Thesis, IIT Bombay, Mumbai,
6. Bhawalkar U S, (1993). Turning garbage into gold: An introduction to vermiculture biotechnology (Bhawalkar Earthworm Research Institute, Pune) 1-40.
7. Bouche M B, (1977). Strategies lombriciennes, in Soil organisms as components of ecosystems, edited by U Lohm & Persson, Biol Bull (Stockholm), 25 122-132.
8. Byzova Yu B, (1965). Comparative rate of respiration in some earthworms, Rev Ecol Biol Soil, 2. 207-216.
9. Chinsamy M, Finnie J, Van Staden J (2014). Anti-inflammatory,antioxidant, anti-cholinesterase activity and mutagenicity of South African medicinal orchids. South Africa Journal of Botany 91:88-98.
10. Curry J P & Byrne D, (1992). The Role of earthworms in straw decomposition and nitrogen turnover in arable land in Greenland, Soil Biol Biochem, 24. 1409-1412.
11. Degwale A., Dechassa N., Fikreyohannes G.F., (2016). Effect of vermicompost and inorganic NPK fertilizer on growth and yield quality of garlic (*Allium sativum* L.) in Enebse Sar Midir District, Northwestern
    Ethiopia. Journal Biology, Agriculture and Healthca re, 6(3): 57-75.
12. Edwards C A & Lofty J R, (1972).Biology of earthworms (Chapman and Hall, London), 1-288.
13. Gajalakshmi S, Ramasamy E V & Abbasi S A, (2001). Potential of two epigeic and two anecic earthworm species in vermicomposting of water hyacinth, Bioresour Technol, 76 177-181.
14. Gajalakshmi & Abbasi, (2003). High-rate vermicomposting systems for recycling paper waste, Indian J Biotechnol, 2. 613-615.
15. Ghosh M, Chattopadhyay G N, Baral K, (1999). Transformation of phosphorus during vermicomposting, Bioresour Technol, 69. 149-154.
16. Ganeshnauth, V, S. Jaikishun, A.A. Ansari and O. Homenauth, (2018). The Effect of Vermicompost and Other Fertilizers on the Growth and Productivity of Pepper Plants in Guyana. Open access peer-reviewed chapter 9. http://dx.doi.org/10.5772/intechopen.73262.
17. Garg, B. K., Gupta, I. C. (2011). Salinity Tolerance in Plants: Methods, Mechanisms and Management. India: Scientific Publishers (India).
18. Han, C.R., Holmsen, E., Carrington, B., Bishop, K., Zhu, Y.J., Starost, M., Meltzer, P., Sood, R., Liu, P., Cheng, S.Y. (2020). Generation of novel genetic models to dissect resistance to thyroid hormone receptor alpha in zebrafish. Thyroid : official journal of the American Thyroid Association. 30(2):314-328
19. Ismail S A, (1997). Vermicology: The biology of earthworms (Orient Longman, Hyderabad), 1-92.
20. Ismail S A, (1998). The contribution of soil fauna especially the earthworms to soil fertility, in Proc workshop organic farming (Institute of Research in soil Biology and Biotechnology, New College, Chennai), 1-9.
21. Kamatchi kala.B et al. (2018). International Journal of Recent Research Aspects ISSN: 2349-7688, Special Issue: Conscientious Computing Technologies, April, pp. 898-901.
22. Kujur A, Kiran KA, Kujur M. (2022). An Epidemiological Study of Outbreak Investigation of

*Corresponding Author: **Laila Khalid**

Chickenpox in Remote Hamlets of a Tribal State in India. Cureus. Jun 30; 14(6):e26454.
23. Kumar C A, (1994). State of the art report on vermiculture in India (Council for Advancement of People's Action and Rural Technology, New Delhi), 1-60.
24. Lee K E, (1985). Earthworms: The ecology and relationships with soils and land use (Academic Press, New York), 1-420.
25. Lian, X., Huang, J., Huang, R., Liu, C., Wang, L., Zhang, T. (2020). Impact of city lockdown on the air quality of COVID-19-hit of Wuhan city. Sci. Total Environ. 742, 140556.
26. Liu, et al. (2011) Trap or Wall: Real Challenge and Strategic Choice Facing China's Economy. Beijing Citic Press, Vol. 5, 34-46.
27. Pantazi, M., Klein, O., & Kissine, M. (2020). Is justice blind or myopic? An examination of the effects of meta-cognitive myopia and truth bias on mock jurors and judges. *Judgment and Decision Making*, 15(2), 214–229.
28. Reinecke A, Viljoen S A & Saayman R J, (1992). The suitability of Eudrilus eugeniae, Perionyx excavatus, and Eisenia fetida (Oligocheeta) for vermicomposting in southern Africa in terms of their temperature requirements, Soil Biol Biochem, 24 1295-1307.
29. Sapre, *et al.* (2021), Molecular Techniques Used in Plant Disease diagnosis, in Food security and Plant Disease Management.Elsevier pp. 405-421.
30. Satchell J E, (1983). Earthworm ecology–From Darwin to vermiculture (Chapman and Hall, London), 1-495.
31. Shang, Y. et al. (2013). Systematic Review of Chinese Studies of Short-Term Exposure to Air Pollution and Daily Mortality. Environment International, 54, 100-111.
32. Singh, R., Kumar, A., et al. (2017) PGPR Isolates from the Rhizosphere of Vegetable Crop Momordica charantia: Characterization and Application as Biofertilizer. International Journal of Current Microbiology Applied Science, 6, 1789-1802.
33. Szczeck M M, (1999). Suppressiveness of vermicompost against Fusarium wilt of tomato, J Phytopathol (Berl), 147 155-161.
34. Theunissen, J., Ndakidemi, P. A., and Laubscher, C. P. (2010). Potential of vermicompost produced from plant waste on the growth and nutrient status in vegetable production. Int. J. Phys. Sci. 5, 1964–1973.
35. Wang J, et al. (2010). Potential and flux landscapes quantify the stability and robustness of budding yeast cell cycle network. Proc Natl Acad Sci U S A 107(18):8195-200.
36. Wang *et al.* (2017). Differing patterns of short-term transitions of nondaily smokers for different indicators of socioeconomic status (SES). *Addiction, 112(*5), 873–874.

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