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Drilosphere: A valuable source for soil microbial activities

Abstract

The basic function of soil microorganisms is the decomposition and transformation of organic materials, which are derived from the plant residues. Thus, soil microbial communities play a critical role in ecosystem processes. Soil microbial activities, populations and communities are governed by environmental variables and agricultural system. The conventional agriculture has an important role in improving food productivity. The earthworms have been modifying soil characteristics for millennia wherever they are found world-wide, it has only been recently that soil scientists described vermic horizons and even vermisols, where earthworm influence on soils reaches dramatic proportions. The earthworm body, both internally and externally, is the site of metabolic processes, at this level, microbial activity is enhanced. The increase of soil porosity in organic system indicated the decrease in soil bulk density which promotes the soil microbial activity.

Keywords: drilospheres, organic system, soil microbes

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Introduction

Microorganisms have main function is decomposition and transformation of organic materials. Hence, their communities play an important role in ecosystem processes in the soil.[1,2] The conventional and organic system governed by microbial activities which is based on environmental factors. Among both systems, conventional agriculture has an important role in improving food productivity which is depend on input of chemicals in the soil.[3] On the other hand, in organic agriculture the synthetic fertilizers and pesticides are not being uses which are highly hazardous to the fields. Now a day, organic agriculture is achieving worldwide acceptance which has expended in the rate of 20% annually since last decade in 24million hectares worldwide.[4] Soil quality has great quality to maintain decomposition, soil formation and many other soil ecological properties which is more important for farming management. The microbes respired in soil and provides valuable nutrients to the soil hence, they have been using as soil quality indicator.[5] The biomasses of these microbes mainly have carbon which is most dynamic component of soil organic carbon, thus, all the microbial activities are most important for soil and we can say they are keys of all soil processes. The drilosphere, an earthworm occupied and surrounding area provides greater niche to these microorganisms.

Drilosphere

The concept of an earthworm sphere is another new approach to the science and researchers which influence the microbial activities in the soil. Earthworms modifies the soil characteristics and make it suitable to microbes on this basis the soil scientists described vermic horizons in which earthworm influence the soil dynamic properties.[6,7] Firstly, the drilosphere was coined by Bouché, the zone upto 2mm around earthworm burrow walls, while Haminton and Dindal used another term vermisphere, which is a soil structure and volume created by earthworm *i.e.* midden.[8,9] Latter on Lavelle expanded the drilosphere, including earthworm populations along with soil volume, microbial and invertebrate populations which is influence by their activities.[6,10] This definition has five main components including:

I. Internal micro-environment of the earthworm gut

II. External environment where earthworm attracts with soil

III. Above and belowground environment

IV. Earthworm originated structure *i.e.* middens

V. Earthworms created burrows.

The earthworm body secretes mucus and nitrogenous excretion in their environment which is useful for soil ecology because the microbial activities have been enhanced in soil which followed decomposition of organic matters and might be act as microbial primers.[11] Earthworm produces castings a by-product of gut passage which are mainly in globular and granular forms; these are characteristics of different in sizes, stabilities and durations even in microbial activities variation.[6] Globular casts are large in size and more stable as compare with granular casts.[6,11,12] Due to more stability globular casts are more important and useful for mineralization.

Drilosphere and porosphere

Soil is generally having millions of naturally occurring pores which are surrounded by the soil fabric while the earthworm generated pores differ from these natural pores because they are coated and surrounded by earthworm body secretions as mucus.[13] Earthworms generate both micro and macropores in the soil and are rich in nutrients and polysaccharides; these nutrients and polysaccharides are important for soil binding and aggregations.[6] Similarly, many of the pore derive by roots in soils which are generally macropores and having similar function as earthworm derives pores.[13,14] All the pores spatially large pores in soil most important for gaseous exchange and water infiltration; thus they take part in the soil microbial activities and follows the decomposition, hence we can say that soil organic matter has been formed due to the change in soil environment. Another function of these pores in soil is leaching of chemicals through the soil profile which can be influenced by earthworms.

Drilosphere and rhizosphere

The rhizosphere (a zone around plant roots) is influenced directly and indirectly by the earthworms which follows the plant growth and production. The direct effects of earthworm are the earthworm feed and activity in rhizosphare while indirectly they affect the soil texture, physiological, physiochemical and biological processes that affect the root and plant growth. Earthworm activities in rhizosphere can be easily access by various visual observations *i.e.* root volume, length and amount; mycorrhizal and soil bacterial activities etc.[6,14–17] Recently organic farming has great importance than the conventional system because of soil organic matters in organic system. Soil bulk density and porosity are correlated to each other; porosity influence by the addition of organic matters which directly affects the bulk density *i.e.* reduction in density; this effect is in organic farming systems and important for root growth and nutrient availability. The higher soil respiration always directly proportional to higher microbial activity in the organic farming system because of continuous addition of organic matters which is most suitable for microbes and follow the high biological activity and rapid decomposition.[3,6] Thus we can say the porosity is directly related with soil organic matters and indirectly with the soil bulk density.[18–21] Hence, decreasing soil bulk density always enhances the porosity due to increase in pore size and numbers which promotes the soil microbial activities follows root growth and productivity.[22,23]

Conclusion

Nutshell, the drilosphere is a valuable niche for soil microbes having basic function in soil including decomposition and transformation of organic materials. All function in soil by microbes play important role in ecosystem processes which improve the soil physical as well as biological processes and finally leads to plant growth and development in agricultural lands.

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Conflict of interest

Authors declare that there is no conflict of interest.

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