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ORIGINAL ARTICLE

Review on Impact and Mitigation Process of Microbial Community in Wheat Fields in respect of climate change

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ABSTRACT

The anthropogenic activities in recent years for enhanced wheat productivity also played role to increase Greenhouse gases concentration affected existing microbial community in crop fields especially under tropical region of the world. These activities resulted in climate change and global warming is the major problem in the world which in turn damage and destroy biotic components. It has also affected microbial community structure and function and also their metabolic activity. The microorganisms and biological components have many potential roles for mitigation with response contributed by contribute forward response. Microorganisms have a wide potential especially used in greenhouse gas treatment and reduction through nutrient recycling. It acts as either generators or users of these gases. It provides to reduce environment hazards which are caused by nature and anthropogenic activity. Generally biogeochemical cycles and climate changes are never see separately.

Key words: *Green-house gases (GHGs), Climate change, Microbial community, Biogeochemical cycle, Methanotropic*

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INTRODUCTION

The climate may be defined as general or average weather conditions of a certain region, including temperature, rainfall and wind. Climate is an interactive system consisting of the atmosphere and biotic components of particular area. The earth's climate is affected by several parameters as latitude, the tilt of the Earth's axis, the movements of the Earth's wind belts, the difference in temperatures of land and sea, and also topography. The Green house effect is the concept for trapping solar radiation by earth's atmosphere traps solar radiation, and is mediated by the presence of gases (carbon dioxide, water vapour and methane) that allow radiation and absorb the heat emitted from the earth's surface. This is provide a blanketing effect in the lower strata of the earth's atmosphere, and this blanketing effect is being enhanced because of the human activities like burning of fossil fuels (Venkataramanan, 2011).

The climate change is problem in present and future as layer of gases surrounding earth getting much thicker through global warming. There climate change and sustainable environment are interrelated. Microorganisms and biogeochemical cycles take place inside oceans, soil, open and closed environment. Both are facilitate the way of making and using greenhouse gases. Microorganisms provide long and short term feedback responses to global warming as well as climate change (Singh, *et al,* 2010). Microbes play an important role as either generators or users of these gases in the environment as they are able to recycle and transform the essential elements as carbon and nitrogen that compose cell as structural and functional unit of life (Joshi and Shekhawat, 2014). Biological method to control greenhouse gas emissions is invaluable regarding to nutrients recycling. Microbial diversity in different ecosystem has many contributions in climate change mitigation due to their versatile metabolism and their presence in broad environmental conditions. Microorganisms can perform uptake, storage and emission of suitable gases in the environment. This review has aimed to evaluate the role of microbes in climate change mitigation and greenhouse gas redaction in future perspective.

EFFECTS OF CLIMATE CHANGE ON MICROORGANISMS

The microbial community composition and their functions are closely related with any changes in climate of a given area. The effect of climate change on microorganisms are listed: death and disturbance, highly influenced metabolic activity, reduction/stimulation of biomass, diversity and composition leads to extinct/shift, having negative or positive result on its physiology and greenhouse gases emission. There is alteration in microbial community structure with rise in temperature and life processes like respiration, fermentation and methanogenesis are also accelerated. The impact of climate change for biotic and abiotic components are the risk of injury, illness, death from the resulting heat waves, wildfires, intense storms, floods rises, distinction, natural disasters, extreme heat, poor air quality, drought and spreading and emerging diseases in animal population. The effect of microorganisms on climate change is accelerated global warming through organic matter decomposition and finally increases the CO_2 flux in atmosphere (Swati, *et al,* 2014; Weiman, 2015). Microbial decomposition of soil carbon is producing a positive feedback to rising global temperatures. Microbial biomass and enzymes is powerful tool to stimulate warming through release of toxic compounds into environment. Temperature directly affects enzyme activity and microbial physiological property. Efficiency of soil microorganisms in using carbon determines the soil carbon response to climate change (Allison, *et al,* 2010; Bradford, *et al,* 2008).

CLIMATE CHANGE MITIGATION MECHANISMS

Microbial processes have a central role in the global fluxes of the key biogenic greenhouse gases and are likely to respond rapidly to climate change. Microorganisms regulate terrestrial greenhouse gas flux which involves consideration of the complex interactions that occur between microorganisms and other biotic and abiotic factors. The potential to mitigate climate change by reducing greenhouse gas emissions through managing terrestrial microbial processes is a tantalizing prospect for the future. It is widely accepted that microorganisms have played a key part in determining the atmospheric concentrations of greenhouse gases (Singh, *et al,* 2010). The major feedback response mechanism for climate change by changing their microbial community structure and composition solve this kind of environmental problem simply, using nutrient cycling processes and stimulating their functional genetic material for degrading and eliminating chemicals or gasses which leads to global warming (Zhou, *et al,* 2011). When microbial communities and biogeochemical cycles are linked together act as a good mechanism to solve climate change.

MICROBIAL COMMUNITIES AND CARBON CYCLE

The global carbon cycle is mainly depending on microbial communities that fix atmospheric carbon, promote plant growth, and degrade or transform organic material in the environment. Large amounts of organic carbon are currently locked in high latitude permafrost, grassland soils, tropical forests and other ecosystems. In another hand, microorganisms play key role in determining the longevity and stability of this carbon and whether or not it is released into the atmosphere as greenhouse gas which means mediate the processes of carbon cycle (Weiman, 2015). Microorganisms are slow down global

warming and implications for crucial ecological processes such as nutrient cycling which rely on microbial activity. Microorganisms are critical in the process of breaking down and transforming dead organic material into forms that can be reused by other organisms. The terrestrial carbon cycle is dominated by the balance between photosynthesis and respiration. Carbon is transferred from the atmosphere to soil via 'carbon-fixing' through autotrophic organisms and microorganisms. Practically, microorganisms use carbon for their metabolism substrate due to these highly consumes atmospheric carbon dioxide.
Soil microorganisms are essential for transfer carbon between environmental compartments to achieve survival through reproduction. Thus, microbes utilize different organic and inorganic forms of carbon as carbon and energy sources. The terrestrial carbon cycle is dominated by the balance between photosynthesis and respiration (Prosser, 2007; Christos, *et al,* 2014).

MICROBIAL COMMUNITIES AND METHANE CYCLE

Carbon cycling between carbon dioxide and organic compounds are considered as ecologically significant. Both eukaryotes and autotrophic bacteria are contributing a great significance role in the fixation of carbon dioxide into organic compounds. Methane (CH_4) is a greenhouse gas enters to atmosphere through microbial action. Methane consuming microorganisms are critical to maintaining a healthy climate on Earth. Bacteria use methane for metabolism as energy source (Semrau, *et al,* 2010; Bousquet, *et al,* 2014). Methanotrophic bacteria are consuming methane as their only source of energy and convert it to carbon dioxide during their digestive process. These bacteria can consume huge amount of methane which is helpful in reducing methane emission from methane producing factories and landfills (Charu, *et al,* 2014; Shindell, *et al,* 2012). Microorganisms are used high amount CH_4 compounds which are found at everywhere (Zimmerman and Labonte, 2015). In anaerobic conditions just like deep compacted mud, carbon dioxide easily changed in to methane through methanogenic bacteria. The conversion process needs hydrogen, yields water and energy for the methanogens. To accomplish the recycling pattern another group of methane bacteria called methane oxidizing bacteria or methanotrophs can convert methane to carbon dioxide. This conversion, which is an aerobic process, also yields water and energy. In the presence of oxygen, CH_4 is oxidized to CO_2 by methanotrophic bacteria. The oxidation of CH_4 to CO_2 completes the carbon cycle. Methanotrophs tend to live at the boundary between aerobic and anaerobic environments. They have access to the methane produced by the anaerobic methanogenic bacteria, but also access to the oxygen needed for their conversion of the methane (Parul, *et al,* 2013).

MICROBIAL COMMUNITIES AND NITROGEN CYCLE

Nitrogen is in elemental form constituting about 78% of the gases in the earth atmosphere. There are also different nitrogen gaseous compounds that exist in the atmosphere including NH_3, NO and N_2O. Nitrogen as very stable molecule (N_2) is unusable by plants and animals without fixation. Nitrogen Fixation is the process of changing atmospheric nitrogen into chemical forms which is usable by living things. N_2 enters in to biosphere via biological fixation. Biological nitrogen fixation will ever totally replace industrial fixation for intensive agriculture. The Specific bacteria (*Rhizobium trifolium*) possess nitrogenase enzymes that can fix atmospheric nitrogen into ammonium ion that is chemically useful to higher organisms As part of the symbiotic relationship, the plant convert the 'fixed' ammonium ion to nitrogen oxides and amino acids to form proteins and other molecules like alkaloids (Jama Bashir, *et al,* 2013).

MITIGATION OPTIONS USED FOR SOLVING CLIMATE CHANGE

The less chemical use is needful on farms through a reduced need to spray crops and minimum use of chemical fertilizer in agriculture and using plant promoting microorganisms which act as a bio-fertilizer in a form of bio inoculation. The use of fossils raw materials must be avoided through replacement with enzymes and microorganism. The bio-fuel and bio-based strategies and targets must be applicable in future. .There potential bio-based carry bags may be applicable to replace their fossil based counter parts with significant and proven in greenhouse gases emission reduction. The introduction of novel species in the ecosystem is necessary. Conservation of groundwater with reduction of water loss from agriculture and application of deforestation all over the world are necessary in changed climate, then carbon sequestration an easily managed.

CONCLUSION

Generally, microorganisms through nutrient cycling act as a break down organic matter release greenhouse gases and speed up global climate change. In another side, it minimizes or compromises the emission of different gases and slows down or prevents climate change by converting to organic form usable for themselves and others. In ecological processes microbes have significant value in consumption/ transformation and production of gases. Biological mechanisms are regulating carbon and nitrogen exchanges between the land, water and atmosphere. Microbial ecology to assess terrestrial carbon cycle play important role for balance ecosystem and stabilize atmospheric condition. Methylotrophs can use greenhouse gases as substrates to fulfill their energy and carbon needs. Greenhouse gases are moving forward to atmosphere during respiration (breathing), decay and combustion (burning). Nature also by itself does a great job of balancing the carbon and nitrogen with in biogeochemical nutrient cycling.

REFERENCES

1. Allison S.D., Wallenstein M.D. and Bradford M.A. (2010): Soil carbon response to warming dependent on microbial physiology. Nat Geo Sci., 3: 336-340.
2. Bousquet P., Ciais P., Miller J.B., Dlugokencky E.J. and Hauglustaine D.A. (2006): Contribution of anthropogenic and natural sources to atmospheric methane variability. Nature, 443: 439-443.
3. Bradford M.A., Davies C.A., Frey S.D., Maddox T.R. and Melillo J.M. (2008): Thermal adaptation of soil microbial respiration to elevated temperature. Ecol Lett., 11: 1316-1327.
4. Charu G., Prakash D. and Sneh G. (2014): Role of microbes in combating global warming. Int J Pharm Sci Lett 4: 359-363.
5. Christos G., Joanna M.C. and Liz J.S. (2014): The role of soil microbes in the global carbon cycle: Tracking the below-ground microbial processing of plant derived carbon for manipulating carbon dynamics in agricultural systems. J Sci Food Agric, 94: 2362-2371.
6. Jama Bashir, Ndufa J.K., Buresh R.J. and Shepherd K.D. (2013): Vertical distribution of roots and soil nitrate: Tree species and phosphorus effects. Soil Sci Soc Am J., 62: 280-286.
7. Joshi P.A. and Shekhawat D.B. (2014): Microbial contributions to global climate changes in soil environments: Impact on carbon cycle. Ann Appl Biosci., 1: 7-9.
8. Parul Rajput, Rupali S., Gourav M., Mohanty S.R, and Archana T. (2013): Biogeochemical aspect of atmospheric methane and impact of nanoparticles on methanotrophs. J Environ Anal Toxicol., 3: 2-10.
9. Prosser J.I. (2007): Microorganisms cycling soil nutrients and their diversity. Modern Soil Microbiology, 237-261.
10. Semrau J.D., DiSpirito A.A. and Yoon S. (2010): Methanotrophs and copper. FEMS Microbiol Rev., 34: 496-531.
11. Shindell D., Johan C.I., Kuylenstierna, Elisabetta V. and Rita V.D. (2012): Simultaneously mitigating near-term climate change and improving human health and food security. Science, 335: 183-189.
12. Singh B.K., Bardgett R.D., Smith P. and Dave S.R. (2010): Microorganisms and climate change: Terrestrial feedbacks and mitigation options. Nat Rev Microbiol., 8: 779-790.
13. Swati T., Ramesh S. and Shaily J. (2014): Effect of climate change on plant-microbe interaction: An overview. Eur J Mol Biotechnol., 5: 149-156.
14. Venkataramanan M. and Smith P. (2011): Causes and effects of global warming. Indian J Sci Technol., 4: 226-229.
15. Weiman S. (2015): Microbes help to drive global carbon cycling and climate change. Microbe Mag., 10: 233-238.
16. Zhou J., Xue K., Jianping X., Ye Deng and Liyou Wu (2011): Microbial mediation of carbon-cycle feedbacks to climate warming. Nat Clim Change, 2: 106-110.
17. Zimmerman L. and Labonte B. (2015): Climate change and the microbial methane banquet. Clim Alert, 27: 1-6.