

Chapter 9

Pesticides and Their Impact on Aquatic Microorganisms

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ABSTRACT

Microorganisms are the most dominant natives of aquatic ecosystems, where they fulfill very specific roles in primary productivity, decomposition, and nutrient cycling. Microorganisms get naturally exposed to pesticides in aquatic environments by the direct and indirect supply. The microorganism can make use of components entering the environment as feeding substrate for building material or a source of energy thus affecting balance in the ecosystem. Natural population possesses a number of responses to these contaminants, and quickest reaction has been reported from the microorganisms. Pesticides may affect the population dynamics by controlling individual reproduction, survival, and by changing sex ratio. The following patterns are recognized as effects of pesticides at the ecosystem and community levels like an increase of species richness reduction of energy transfer efficiency from primary producers to top predators. Thus, the purpose of this chapter is to review the significance of pesticides and their effects on aquatic microorganism and to study their ecological significance.

INTRODUCTION

Microorganisms are important natives of aquatic ecosystems, where they perform very important roles in primary productivity, decomposition and nutrient cycling. Aquatic ecosystems get indirect and direct pesticide supplies, imminently exposing microorganisms to pesticides. Moreover pesticides cause various chronic and acute toxic effects in microorganisms, microorganisms also have the ability to detoxify or metabolize and accumulate pesticides to some extent. Adverse effects of pesticides on the species of microorganisms may have proximate influence on top trophic levels. For example, shifts in community design of zooplankton grazers can affect their growth rate or lead to many changes in the macromolecular composition of species of phytoplankton (Ahlgren *et al.*, 1990). Aquatic environments serve as critical

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nursery and feeding grounds for many aquatic organisms, including recreationally and commercially important shellfish and fish species. These diverse, productive environments are specifically sensitive to pesticidal pollution because they serve as storage places for pesticidal pollutants from upland sources. There is scarcity on the data of toxicity involving pesticides and microorganisms. Several investigations have targeted microbial degradation of pesticides rather than examining effects of pesticides on natural microorganism populations. Moreover, investigations of pesticidal effects on soil microbes are indeed far more common than investigations of those in aquatic environments.

Aquatic microorganisms include members of the protozoa, bacteria, plant kingdom and fungi. These aquatic microorganisms radically differ from each other but are similar only in their small size; most of them can be detected with the help of microscope, although colonies of many can be detected with the naked eye (Muturi *et al.*, 2017). Microorganisms are present in huge numbers everywhere and can survive even in unfavorable chemical and physical environmental conditions. Several aquatic microorganisms play basal roles in aquatic environments, trapping the light energy by the process of photosynthesis and moreover, they are considered to play an important role in liberating nutrients stored in organic tissue and also help in decomposition.

Bacteria

Most of the ancient and smallest organisms on the planet earth are bacteria; they are cosmopolitan in distribution i.e. present almost in every ecosystem and are far more abundant in all aquatic ecosystems. In streams and rivers, most of the bacteria penetrate in aquatic ecosystems from the surrounding land and their richness can increase adequately after a rainfall. The number of bacteria is measured in millions per milliliter (ml), and in the hundreds of millions per milliliter especially in polluted waters (Lydia, 2015).

If circumstances are favorable, bacteria divide rapidly by simple division to produce very large numbers of colonies in a very less time. Bacteria can be found emerged in the water, united with dead and decaying material (such as leaves or dead wood), or layered the surface of sand grains, stones and rocks as part of the biofilm (the lubricious layers on hard surfaces in rivers). They can make up a huge number of the living material in aquatic ecosystems (McArthur, 1992).

Bacteria exhibit the greatest magnitude in metabolic ability of any group of aquatic organisms. There are both heterotrophic and autotrophic bacteria. Autotrophic bacteria are primary producers in aquatic ecosystem as are true algae. So, for this reason, autotrophic bacteria (mostly cyanobacteria) are often referred as 'algae', although these aquatic microorganisms are by no means closely related to each other. Cyanobacteria used to be mistakenly known as 'blue-green algae'. Actually ecologically, much of features what applies to algae is similar to autotrophic bacteria.

While as Heterotrophic bacteria act as decomposers and are considered a very important link in the decomposition of organic matter and the cycling of nutrients in aquatic environments.

Fungi

Fungi are present as a single cell or in filaments known as hyphae. Most aquatic fungi known as hyphomycetes are microscopic and are the most abundant in number and are very important (Lewin, 1974).

Fungi like heterotrophic bacteria are heterotrophic which attain their food by releasing exoenzymes into their existing environment, which helps to breakdown complex molecules into simpler and soluble substances that fungi can absorb. Fungi also act as decomposers as they are able to decompose plant

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