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Studies on Effect of Pesticides on Soil Microbiological Activities: An Overview

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Abstract

Pesticidesare widely used in agriculture for control of various insect pest population. The application of pesticides starts from the pre sowing stage. Different treatments includesoil application, seed treatment, foliar spray, etc .Repeated and extensive application of the pesticide have severe effects on soil ecology as appreciable quantities of pesticides and their degraded products accumulate in the soil ecosystem and disturb the soil environment by affecting flora and fauna including microflora of soil, even the physicochemical properties of soil is affected leading to infertility of soil. The effect of agricultural inputs on soil organisms can be measured either as changes in the amount of single organisms, organism groups or methodologically defined pools such as the microbial biomass, or as changes in biological activity, e.g. soil respiration and enzyme activities. Soil microorganisms show an early warning about soil disturbances by foreign chemicals than any other parameters.In essence, soil quality is the very foundation of a more sustainable agriculture**.** So it is indispensable to monitor the degradation of pesticides in soil and is also necessary to study the effect of pesticide on the soil quality or soil health by in depth studies on soil microbial activity.

Keywords: Pesticides, Soil microorganism,microbiological activities

Introduction:

Pesticides are the important agrochemicals that are used to control or inhibit plant diseases and insect pests , however indiscriminate use of pesticides have severe effects on soil ecology as appreciable quantities of pesticides and their degraded products accumulate in the soil ecosystem and disturb the soil environment by affecting flora and fauna including microflora of soil, even the physicochemical properties of soil like pH, salinity, alkalinity are affected leading to infertility of soil. Soil microflora makes a valuable contribution in making the soil fertile through their primary catabolic role in the degradation of plants and animal residues. Soil fertility reflects the microbial status of soil as soil microflora makes the valuable contribution in making the soil fertile. The amount of applied pesticides reaching the target organism is about 0.1%, while the remaining bulk contaminates the soil environment.[1]The entry of pesticides in soils may disturb the delicate balance of microflora thereby affecting recycling of nutrients and hence soil fertility. [2] Pesticides interact with soil microorganisms altering the physiological, biochemical properties and their metabolic activities.[3] The pesticides reduce soil enzymatic activities that act as biological index of soil fertility and biological processes in soil environment. Pesticide that disrupt the activities of the soil microorganisms could be expected to affect the nutritional quality of soils and would therefore, have serious ecological consequences. In essence, soil quality is the very foundation of a more sustainable agriculture.[4] The effect of

agricultural inputs on soil organisms can be measured either as changes in the amount of single organisms, organism groups or methodologically defined pools such as the microbial biomass, or as changes in biological activity, e.g. soil respiration and enzyme activities. An alternation in soil microbial populations, diversity and activity may serve as indicators of soil fertility or quality.[5] Thus, the analysis of soil enzymatic activity is per-requisite in order to estimate the soil biological response used for soil quality assessment and to understand the effect of pesticides on soil properties.

Persistence of pesticides in soil: The persistence of pesticides in soil varies from a week to several years depending upon structure and properties of the constituents in the pesticide and availability of moisture in soil. For instance, the highly toxic phosphates do not persist for more than three months while chlorinated hydrocarbon insecticides (eg. DDT, aldrin, chlordane etc) are known to persist at least for 4-5 years and some times more than 15 years. From the agricultural point of view, longer persistence of pesticides leading to accumulation of residues in soil may result into the increased absorption of such toxic chemicals by plants to the level at which the consumption of plant products may prove hazardous to human beings as well as livestock's. DDT persists for longer period and thereby got accumulated in the food chain leading to food contamination and health hazards. Therefore, DDT and mercurial fungicides has been, banned to use in agriculture as well as in public health departmen

Role of Microorganisms in degradation of organic matter and pollutants in soils.

Certain soil bacteria can degrade pesticides [6][7].Pesticide applied in environment are transformed in biological and non biological processes into one or mere transformation products. These transformations are carried out by different mechanisms through physical, chemical and biological agents in which microorganisms play a significant role. The transformation mechanism includes oxidation hydrolysis reduction conjugation etc, catalyzed by various types of enzymes resulting in usually less bio active products. Therefore in recent times the role of microorganisms in pesticide degradation dealt with utmost sincerely. The soil quality is those soil functions that allow soil to accept, store and recycle water, nutrients and energy. Soil quality does not depend just on the physical, physicochemical and chemical and chemical properties of soil but closely linked to the soil microbiological properties [8] . Microorganism has the following benefits of chemical and photosynthetic production and in the consumption and breakdown of organicmatter and release of nutrients,fixation of atmospheric nitrogen, decomposition of organic wastes and residues, suppression of soil-borne pathogens,recycling and increased availability of plant nutrients,

degradation of toxicants including pesticides, production of antibiotics and other bioactive compounds, production of simple organic molecules for plant uptake, complexation of heavy metals to limit plant uptake,solubilization of insoluble nutrient sources and production of polysaccharides to improve soil aggregation.

Effect of pesticide on soil microbiological parameters

The degradation pathway of a pesticide in soil is difficult, but the use of various biochemical indicators can help the impact of a pesticide on soil to be better understood Biochemical indicators, such as soil enzymes, biomass, respiration, *etc.*, are often used to characterize the effects of pesticides on the environment[9]

1.Microbial biomass

Microbial biomass in soils is considered as an important attribute of soil quality [10] and is an ecologically important parameter as it is the main agent that supports the soil function and associated processes involved with the storing and cycling of nutrients and energy and ecosystem functioning. Several workers have studied the effects of pesticide application using this parameter. Vischetti*et al.* [11] studied the relationship between the degradation of rimsulfuron and soil microbial biomass carbon in a laboratory incubated clay loam soil. Haney *et al.* [12] determined the effect of isopropylamine salt of glyphosate on soil microbial biomass and activity across a range of soils varying in fertility. Studies have shown that if the pesticides are used in recommended doses it will be safe to soil microorganisms and their activities .

2. Soil Respiration

Soil respiration is an ecosystem process that releases carbon dioxide (CO_2) from soil root respiration, microbial decomposition of litter and soil organic matter and fauna respiration. The biochemical activity of a soil, therefore, can be quantified by measuring CO_2 evolution. Soil respiration is one of the oldest and still the most frequently used parameter for quantifying activity in soil.The metabolic activities of soil microorganisms can, therefore, be quantified by measured CO_2 evolution .Measurement of soil respiration is an effective tool to characterize the microbial status of soil and hence bioindicators of soil health or soil quality . Soil respiration was most frequently used for assessment of the side effects of chemicals, such as heavy metals, pesticides etc .Urkude et.al.,[13] concluded that the fortification level upto 20 ppm for lindane 20 EC seemed to be comparatively safe for earthworm population in the soil . Zelles et al. investigated the effects of some herbicides (atrazine, pentachlorophenol, 4-chloroanile and chloroacetamide), fungicides (zineb and captan) and

insecticides (lindane and 4-nitrophenol) on soil respiration. Martinez-Toledo et al. [14]showed that nitrifying bacteria in soil were negatively affected both by the insecticide lindan and the fungicide captan when used in accordance withthe recommendations of the manufacture.It can be seen from these studies that normal doses of pesticides has only slight effects on soil microflora and microorganisms are capable to recover rapidly.

3. Soil enzymes

Soil enzymes are remarkable biomolecules that show extraordinary specificity in catalyzing biological reactions, important for both soil microorganisms and plants [16]. Further, they act as important indices of soil fertility. The extensive application of pesticides leads to interference with the normal enzymatic activity of proliferating soil microorganisms, and disturbing the delicate balance of soil ecosystem[17].

Conclusion:

The fate of the pesticides in the soil environment in respect of pest control efficacy, non-target organism exposure and offsite mobility has become a matter of environmental concern potentially because of the adverse effects of pesticidal chemicals on soil microorganisms and effect on soil fertility .So it is indispensable to monitor the persistence, degradation of pesticides in soil and is also necessary to study the effect of pesticide on the soil quality or soil health by in depth studies on soil microbial activity however studies has shown that pesticides at normally recommended field rates and intervals are seldom deleterious to microorganisms and their activities.

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