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Agrochemicals Affecting Soil Enzymatic Activity

(*Kundan[1], Vishnu Bapurao Gore[2], Devendra Kumar[3], Shilpee Kumari[4] and Sonu Bharti[5])
[1]M.Sc. (Agri) Student, Department of Biochemistry, JAU, Junagadh
[2]PhD, Biochemistry, Department of Biochemistry, MPKV, Rahuri
[3]PhD Scholar, Department of Biotechnology, JAU, Junagadh
[4]B.F.Sc., Kishanganj, Bihar
[5]B.Sc. Agri., IARI, Jharkhand
*Corresponding Author's email: sumansourav.get@gmail.com

Enzymes respond to soil management changes long before other soil quality indicator changes are detectable. Soil enzymes play an important role in organic matter decomposition and nutrient cycling. Some enzymes only facilitate the breakdown of organic matter (e.g., hydrolase, glucosidase), while others are involved in nutrient mineralization (e.g., amidase, urease, phosphatase, sulphates). With the exception of phosphatase activity, there is no strong evidence that directly relates enzyme activity to nutrient availability or crop production.

An agrochemical or agrichemical, a contraction of agricultural chemical, is a chemical product used in agriculture. In most cases, agrichemical refers to pesticides including insecticides, herbicides, fungicides and nematicides. Agrochemicals fall into categories as 1. Plant Protection Chemicals- Insecticides, Fungicides, Herbicides, Rodenticides, Nematicides, Acaricides, Molluscicide. 2. Plant Growth Regulators-Growth Promoters, Growth Retardants. 3. Fertilizers-Simple, Straight, Complex, Micronutrients. 4. Soil Conditioner & Animal Husbandry Chemicals-Antibiotics, Hormones (Mandal *et al*. 2020). The rate of enzymatic reactions in soil fluctuates with seasons and it is determined mainly by the concentration of enzymes and substrates participating in the reactions, influenced especially by pH, granulometric composition, temperature and the presence of activators and inhibitors Soil enzymes enter humus–enzyme complexes, changing their kinetic properties and resistance to thermal denaturation and proteolytic degradation However, the stability of the enzymes in soil depends on the binding mode, the number and type of chemical bonds between the enzyme and the sorbent, the chemical and physical properties of the sorbent phase, the changes in the molecular conformation of the enzyme and the chemical conditions of the microenvironment surroundings (Nannipieri *et al*., 2012).

Soil enzymes

Soils, in general, comprise various enzymatic pools that consist of free enzymes. Immobilized extracellular enzymes, and enzymes excreted by (or within) microorganisms.

Types of soil enzymes:

1) Constitutive Soil enzymes: Always present in nearly constant amounts in a cell that are not affected by addition of any particular substrate, genes are always expressed. (Pyro-phosphatase).

2) Inducible Soil enzymes: Present only in trace amounts or not at all, but quickly increases in concentration when its substrate is present. (Amidase).

Both enzymes are present in the soil (Kaur *et al*. 2020). Soil microbial enzymatic activities are the indicators of soil biological health, fertility, and chemical status. Agrochemicals incorporated in the soil eradicate beneficial soil microbes which are involved in important enzymatic components like chain of reactions that play vital role in synchronizing important chemical processes in soil (Malik *et al* 2017).

Influence of pesticides on biological soil activity: Soil biota and micro flora are key elements that respond to any agrochemical. Pesticides inhibit or kill certain group of microorganisms by reducing the competition of certain groups; it reduces microbial diversity but increases functional diversity of microbial communities. Some positive effects of pesticides on soil microbial diversity are seen as some microbes are capable of utilizing applied pesticides as a source of energy and nutrients for their growth (Devi *et al*., 2018).

Effect of agrochemicals on soil enzymatic activity: Agrochemicals, particularly pesticides, that reach the soil may adversely affect the microbial metabolism or can alter the soil enzymatic activity. Measuring the change in enzymatic activity has been classified as a biological indicator to identify the impact of chemical substances including pesticides on soil biological processes and functions. Several studies indicate both increase and decrease of soil enzyme activities such as hydrolases oxidoreductases and dehydrogenases due to the presence of pesticides. The effect of pesticides widely varies on soil enzymatic activities based upon the pesticide type's soil types and prevailing condition (Mandal *et al*. 2020).

Other Factors Affecting Soil Enzyme Activities: Assays in a lab setting are often conducted at constant pH, temperature, soil moisture, etc., therefore they cannot reveal how sensitive an enzyme activity is to changes in these variables. Minor changes that are made to experimental. Since a variety of factors, including changes in soil management, plant cover, alterations in the environment, and the presence or addition of fertilisers can affect soil enzyme activities. Environmental pollution, additives like fertilisers, pesticides, salts, and heavy metals, etc.) and natural (i.e. physio-geological, geographical, or physic-chemical properties of soils, organic, clay, or biomass contents, etc.) factors may have an impact on soil enzyme activities.

Case Studies

Molaci *et al* (2017) used chlortetracycline and sulfapyridine antibiotics to screen out their effects on dehydrogenase, alkaline phosphatase and urease activity and concluded that pharmaceutical antibiotics might exert undesirable effects on soil microbial functions, such as enzyme activities, depending on the microbial parameters considered and the kind of antibiotics used.

Micati *et al* (2018) found that four pesticides commonly used in Romania, Ridomil Gold MZ 68WG, Bravo 500 SC, Mospilan 205G and Vertimec 1.8 % EC to highlight the influence of them on soil enzymatic activity as the fungicide. Ridomil Gold profoundly decreased the amylase and urease activity and enhanced the cellulase activity at doses recommended by the trader. Similar results were observed on the amylase and urease activity after Bravo 500 application. In addition, the cellulase and xylanase activities were increased by the both insecticides applied at recommended levels to control insect pests.

Conclusion

Numerous biotic and abiotic variables, as well as soil characteristics, influence how agrochemicals affect the microbiological and biochemical health of the soil. Long-term use of agrochemicals in agriculture may have harmful effects on soil microbial activity and soil processes that affect crop productivity and soil nutrient cycle. In agrochemical-contaminated soils, the health of the soil's biochemistry and the activity of its enzymes might be the most crucial quality indicators. To keep the ecological balance and soil health, agrochemicals must

be used in the best and most effective way. With respect to the use of agrochemicals, it is discovered that the enzyme activity of several soil enzymes either rise or decrease.

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