

Soil Pollution Status and Impact of Pesticides on Crop Development in Selected Region of Jhunjhunu District, Rajasthan (INDIA)

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ABSTRACT

Pesticides applied to the soil tend to be a mixture of different active substances. Therefore, it isn't easy to analyze their influence on the biological activity of the soil. The research work done from Nawalgarh and Mukundgarh region of Jhunjhunu district in October 2022 to December 2022. This review attempts to discuss the activity of such compounds on microbial community and soil pollution status in the rural and urban area. It also investigates the degradation of pesticides in soil and the prevention of their negative effects on soil biological activity. So far, almost no studies offer a comprehensive view of biological activity in soil, with little attention paid to the effect of different pesticides and their metabolites. The impact of pesticides on soil health is still a current and important issue that requires constant monitoring. This review summarizes the latest scientific reports on soil enzymes, microbial events, and changes in below-ground biochemistry under the influence of pesticides. Enzymatic and microbiological responses following pesticide application are difficult to interpret due to their physical diversity and diversity of degradation pathways. The optimization of agricultural production has recently become necessary to meet the food needs of the growing world population. To address this formidable challenge, the application of agrochemicals, including synthetic pesticides in intensive farming practices, has increased alarmingly. However, the excessive and indiscriminate use of pesticides to promote food production leads to its extreme confession in the soil.

Keywords: Pesticides, microbial community, soil, degradation pathways.

INTRODUCTION

Changing climate conditions, including global warming and increased temperature, negatively affect agricultural productivity. The optimization of agricultural production has recently become essential to meet the food

needs of the growing world population. To address this formidable challenge, the application of agrochemicals, including synthetic pesticides, in intensive agriculture practices has increased disturbingly.

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However, the excessive and indiscriminate use of pesticides to promote food production leads to excessive soil deposition. After accumulation in the soil beyond a threshold, pesticides negatively affect the rhizosphere microbiota's abundance, diversity, composition and function. In addition, the cost of pesticides and the emergence of insect resistance to pesticides are other reasons for concern. For this reason, the loss of soil nutrients leads to a significant reduction in agricultural output, which justifies the search for new environmentally friendly technologies for sustainable agricultural production. The bacteria in the rhizosphere, in this context, play an important role in detoxifying the polluted environment, making the soil suitable for cultivation through the detoxification of pollutants and the treatment of the rhizosphere., bioremediation, pesticide degradation and stress decrease, resulting in optimized performance. Sustainable agricultural practices are the basic need of the current scenario to alleviate problems arising from current climate conditions and ensure food security. Biology is one of the sustainable approaches to agriculture. In this chapter, beneficial fungal bacteria are discussed in relation to their use as biofertilizers, biological control agents and also in the mold treatment of contaminated soils. Fungi are ubiquitous in nature, possessing rapid adaptability and diverse metabolic activity in natural systems. In soil, fungi can sustain themselves under different environmental conditions by

producing different types of spores. These bacteria contribute significantly to the ecosystem's maintenance by decomposing behaviour either as a biofertilizer or organic control factor.

The response of soil microorganisms to a wide range of chemical pesticides varies widely, from adverse to killing beneficial bacteria. At the cellular and biochemical levels, pesticides destroy morphology, infrastructure, cell viability/permeability, and many biochemical reactions, including protein profiles of soil bacteria. Some pesticides also disrupt the molecular interactions between plants and their symbionts, hindering all useful biological processes. However, the harmful effects of pesticides on soil bacteria have not been fully studied. This review highlights recent findings regarding the potential effects of synthetic pesticides on a wide range of soil microbiota. Focus is placed on researching and recommending strategies to minimize the use of chemical pesticides under real world conditions to preserve the viability of useful soil bacteria and soil quality for production. Safe and sustainable agricultural production even in pesticide-contaminated soil.

MATERIALS AND METHODS

Study Site-

The research work done from Nawalgarh and Mukundgarh region. Field survey and soil samples were collected from fields nearby Mukundgarh and Nawalgarh.



Figure 1- Jhunjhunu district on Rajasthan Map

Soil samples-

The soil sample collected in glass bottle for laboratory test.

Soil testing-

Soil material for chemical analysis was collected from each CL and natural (NH) horizon separately. The collected material was air dried and sieved through a 2 mm mesh plastic sieve. Detailed information on fieldwork and soil sampling, with the basic properties (Corg, pH, texture) of the soil studied, can be found in Mazurek et al. (2016). Soil texture was determined by air mass method described by Bouyoucos and method modified by Cassagrande & Prószyński (Polish Standard, 1998). The soil sample's organic carbon (Corg) content was analyzed according to the Tiurin method (Lityński et al., 1976). Potentiometric measurements of pH were performed using a glass electrode and a pH meter CPI-551 (Elmetron company) in 1 mol dm³ KCl.

Soil profile-

Soil samples were taken from the profile below the Nawalgarh and Mukundgarh region with a total depth of 22 cm. In general, the studied land is divided into distinct sections:-

- (i) the upper part of the soil profile includes 13 CL, horizon, from 0 to 22 cm.
- (ii) (ii) burial ground consisting of 5 NH, Ab, Bw, Bw1, Bw2 and C, starting from a depth of 224 cm to the bottom of the section, 292 cm. Soil has been classified according to WRB (IUSS Working Group WRB, 2015). The age of the deepest CL is estimated based on archaeological, while the surface layer was formed in the late.

Soil texture- pH value and organic carbon content Particle size analysis indicates that some CLs have a sandy texture and others a sandy texture. In NH, sand predominates. The total sand content of in CL was lower than in NH and ranged from 81 to 95% and 93 to 98%, respectively. The proportion of alluvium in CL ranged from 4 to 16%, while in NH it ranged from 2 to 6%. The clay content (<2 mm) in CL was lower than in NH and did not

exceed 4% and 2% respectively (Mazurek et al., 2016).

Apparatus-

Pesticide recycling equipment has been designed and manufactured based on recovering liquid pesticides not retained in the research area. The device is built on the basis of the commercial air-assisted sprayer, which is used for pest and disease control in the study site. The sprayer is equipped with an axial fan that generates the necessary airflow to agitate the canopy leaves, thus allowing liquid pesticide deposition on both sides.

RESULTS AND DISCUSSION

The research work deals with the study of pesticide impact and fourteen pesticides have been screened and identified through a fast, easy, inexpensive, effective, robust and safe extraction process (QuEChERS) in combination with GC-MS/MS in Nawalgarh and Mukundgarh region. The objective of the present survey was to report on the presence of organochlorine (OCP) and organophosphate (OPP) pesticide residues as well as pyrethroid (PYR), carbamate and biopesticide groups. using a combination of QuEChERS and GC-MS/Ms techniques. in agricultural soils in the Mukundgarh and Nawalgarh region, and to study the correlation between the amount of pesticides lost in the soil and some physico-chemical properties of pesticides, especially the distribution of pesticides. octanol-water coefficient (Kow) and vapor pressure (Vp). Predicting the fate of pesticides taking into account both the physico-chemical properties of pesticides and the soil will facilitate the management of pesticide use and reduce the risk of environmental pollution. Soil/air exchange, water interactions and biodegradation generally control the fate of pesticide residues in the soil. The results indicated that for 14 pesticide residues measured in samples collected from various soils, spinosad, methyl chlorpyrifos, dimethoate, chlorpyrifos, lindane (γ -HCH), permethrin and methomyl were the sources of contamination. Most contaminated in the study

area. p,p-DDT, o,p-DDT, bifenthiol, β -cyfluthrin and methidathion were less frequently detected. The single-parameter least squares (sp-LSRE) regression equations for V_p and K_{ow} for the loss of each pesticide residue showed a significant change in concentration ($p < 0.05$) between two seasons.

The outcomes show that gas pressure and octanol-water divider co-efficient data are insufficient to model pesticide residue losses in arid soils with lower carbon content. More soil data are needed to characterize the dispersion mechanisms of these pesticide residues in the region.

Table 1- Pesticide chemical group, impact and properties

S.N.	Pesticide impact and properties	Effect on Microorganism	Pesticide chemical group
1.	Selective, absorbed through leaves and root.	<i>Pseudomonas putida</i> , <i>Flavobacterium</i> , <i>Ralstonia</i>	Chloroacetamide
2.	an acetyl CoA carboxylase inhibitor and inhibits fatty acid synthesis (ACCrue).	<i>Eutropha</i>	Diphenyl ether
3.	Selective, systematic, absorbed through roots and increase biosynthesis and production of ethylene causing uncontrolled cell division and sm damages vascular tissue. synthe dc auxin.	<i>Ptstalotiopsis</i> spp	Alkylchlorophenoxy
4.	Induces accumulation of tetrapyrroles which anack plant cells, inhibition of protoporphyrinogen oxidase (PPO).	<i>Trichmporm domtsricwn</i>	Organochlorine
5.	Selective, inhibition of cell division and fatty acid	<i>Sphingobiwn quisquUiarum</i> <i>Sphingobiwn lxdtri</i> <i>Mycobacreriwfonuirum, bacillus</i> <i>, Microbactriurn sp., Gordmia</i> <i>polyi.sopnnttvCTaru,</i>	Phoophonoglycine
6.	systemic with contact action acts by leaf and shoot.	<i>Canamonas</i> sp. <i>Sphinpyxis</i> spp	Sulfonylurea
7.	inhibiting photosynthesis at Photooystem D.	<i>Pseudomonas utrichous</i> BY·I,	Triazine
8.	Selective, absorbed by leaves and roots. Inhibits growth	<i>Brevundimonas</i> sp. <i>Flavcbacttriaceae,</i> <i>Pseudomonoidaceae,</i> <i>Sphingobactreriaceae</i>	Triketone
9.	protoporphyrinogen oxdase (PROTOX), leading to drought stress	<i>Arrhrobacrer</i> sp, <i>Achromobacur</i> sp., <i>Straptomyus</i> sp.,	Uracil
10.	irreversible cell membrane damage.	<i>Pseudomonas</i> spp. <i>Bacillus</i> spp	Urea

Table 2- Soil properties of Rural and Urban area

Sample	pH	Sand (g kg ⁻¹)	Clay (g kg ⁻¹)	Pb (mg kg ⁻¹)	Zn (mg kg ⁻¹)	Cu (mg kg ⁻¹)	Ni (mg kg ⁻¹)
Rural 1.	7.3	704	79	50	172	109	84
Rural 2.	7.1	709	75	59	149	78	69
Rural 3.	7.4	692	77	54	142	85	56
Urban 1.	6.8	690	89	110	392	180	154
Urban 2.	6.9	720	86	118	410	145	129
Urban 3.	7.2	708	88	107	455	174	117

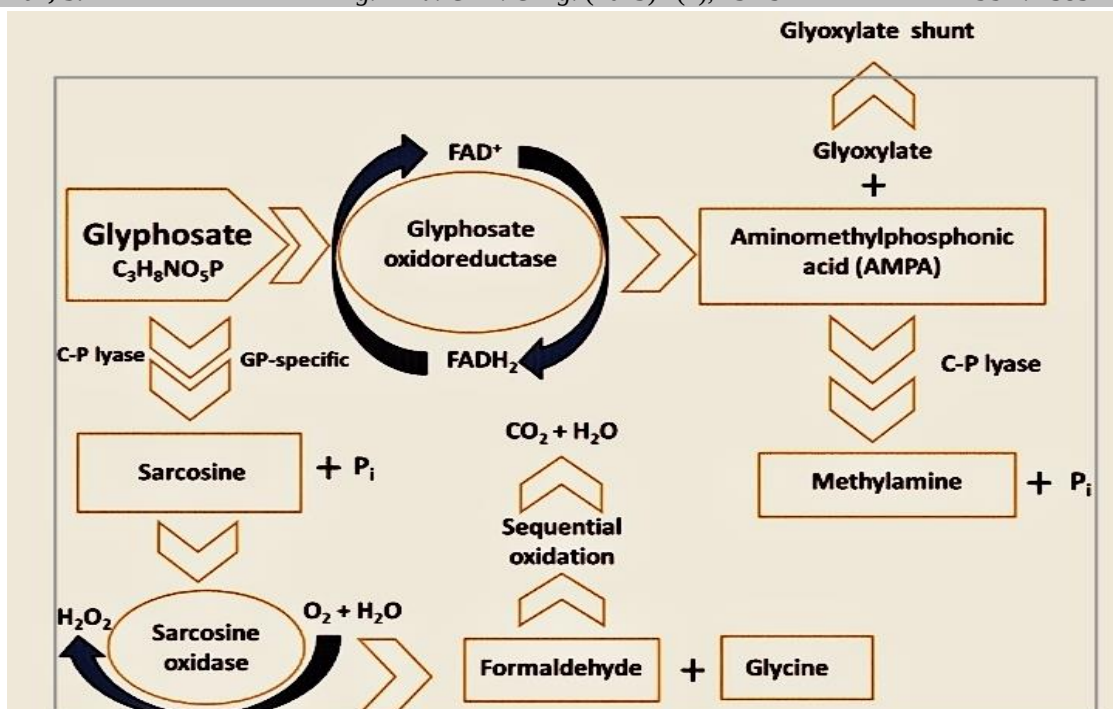


Figure 2- Microbial degradation of glyphosate via AMPA and via sarcosine (Sviridov et al., 2015)

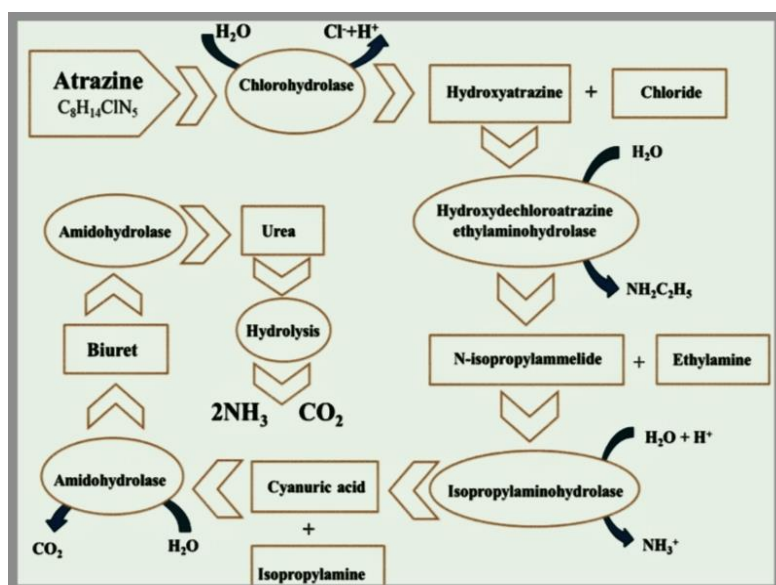


Figure 3- Pathway enzymatic degradation of atrazine in soil (Lin et al., 2011)

CONCLUSION

Pesticides are seen as a boon to farmers worldwide as they optimize agricultural productivity and provide many secondary benefits to society. However, queries regarding the safety of pesticides are regularly elevated due to their risks to human health and the environment. While the risks associated with pesticide use cannot be completely eliminated, the toxicity of pesticides to soil, bacteria, plants, and human health can be significantly reduced.

The role of plants in controlling and reducing soil pollution (phytoremediation) is a decrease in human diseases, the extinction of many plant, grass species and the risk of threatening generations of animals is strong evidence support the above declaration. To this end, biologists and ecologists have been forced to think about natural ways to combat pollution. The use of plants is a simple biological route that is most important because it is a non-technical, cost-effective, and technologically profitable method.

As a result, soil loses its structure and the important nutrients are present in the soil. Some causes of soil pollution may include:

- Industrial wastewater such as toxic gases and chemicals release in rural area and water body.
- Use of chemicals in agriculture such as pesticides, fertilizers and pesticides. Inadequate or ineffective land management system.
- Unfavorable irrigation practices. Poor management and maintenance of septic systems.
- Sanitary waste leaks. Toxic smoke from industries mixed with rain causes acid rain.
- Fuel leak from car washed away by rain and settled on surrounding land.
- Unhygienic waste management techniques dumping wastewater into nearby landfills and water sources.
- The use of pesticides in agriculture retains chemicals in the environment for a long time.
- These chemicals also affect beneficial organisms such as earthworms in the soil and lead to soil quality. least.
- Lack of proper waste treatment system dispersed waste in the ground. These contaminants can block the flow of water through the soil and affect its ability to hold water.
- Unscientific disposal of nuclear waste contaminates soil and can cause mutations.

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Conflict of Interest:

There is no such evidence of conflict of interest.

Author Contribution

All authors have participated in critically revising of the entire manuscript and approval of the final manuscript.

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