



## THE EFFECT OF PESTICIDES ON THE ENVIRONMENT AND LIVING ORGANISMS

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Article info	Abstract
<p><b>Received:</b> 2022-03-13 <b>Accepted:</b> 2022-05-18 <b>Published:</b> 2022-06-30</p> <p><b>Article Review</b></p> <p><b>DOI-Crossref:</b> <a href="https://doi.org/10.32649/ajas.2022.175385">10.32649/ajas.2022.175385</a></p> <p><b>Cite as:</b> Mahdii, B. A., Y. F. Al Fatlawy., and L. J. Sultan. (2022). the effect of pesticides on the environment and living organisms. Anbar Journal of Agricultural SCIENCES, 20(1): 36-44.</p>	<p>The current report dealt with the effect of pesticides on the ecosystem through their impact on soil, water, and microorganisms and their impact on human health. As well as this study dealt with the biodegradation process of pesticides and the organisms involved in this process, even some previous studies proved that <i>Bacillus</i> spp. And <i>Pseudomonas</i> sp. Bacteria is the most efficient in the biodegradation of pesticides, at the same time, other previous studies dealt with the environmental factors that affect the biodegradation process of pesticides. It proved that each of the incubation periods, pH, and temperature have different effects on biodegradation.</p> <p>Most of the studies indicated that the best incubation period for biodegradation is 7-8 days, and the best pH is 7, and the best temperature at which makes the biodegradation start is 10-45 °C.</p>

**Keywords:** Soil, water, microorganisms, pesticides

### تأثير المبيدات على البيئة والكائنات الحية

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### الخلاصة

تناول التقرير الحالي إثر المبيدات في النظام البيئي من تأثيراتها على التربة والمياه والاحياء المجهرية وكذلك تأثيراتها على صحة الانسان، كما تناول ايضا ماهية التحلل الحيوي للمبيدات ومن هي أكثر الكائنات الحية التي تشارك في عملية التحلل الحيوي حيث من خلال الدراسات السابقة اثبتت ان بكتريا *Bacillus spp.*

وبكتريا *Pseudomonas sp* هي الاكفأ في عملية التحلل الحيوي للمبيدات، في حين تناولت بعض الدراسات العوامل البيئية المؤثرة في عملية التحلل الحيوي للمبيدات، إذ اثبتت ان لكل من فترة الحضانة ودرجة الاس الهيدروجيني والحرارة تأثيرات متباينة على عملية التحلل الحيوي. اشارت اغلب الدراسات ان أفضل فترة حضانة للتحلل الحيوي هي بين 7-8 ايام وأفضل اس هيدروجيني هو 7 وأفضل درجة حرارة تبدأ فيها عملية التحلل الحيوي هي 10-45 م°.

**كلمات مفتاحية:** التربة، المياه، الكائنات الدقيقة ومبيدات الآفات.

## Introduction

Allah created the universe in a superb balance, and when humans started using the chemicals in an elegant way which led to a disorder in the natural balance. Pesticides used in pest control are among the most dangerous and widespread chemicals (2).

Pesticides are one of the main reasons of agricultural land pollution, as a result of unscientific and careless customs and methods and the lack of sufficient awareness of how to use pesticides and deal with toxic compounds, which has a negative impact on agricultural environments (7).

The use of organic pesticides increased in the control since it was known during the forties of the last century until now due to its characteristics attracted the attention of farmers in all countries of the world (8), when microorganisms are exposed to pesticides, this process will develop mechanisms to adapt with these conditions, and the development of these mechanisms is essential and this represented by biodegradation, as the biodegradation will happen by the enzymes which responsible of the decomposition of natural materials, and these enzymes stimulate natural chemicals response , but the other part of pesticide compounds needs time to stimulate the enzymes in order for these induced enzymes to work On the decomposition of pesticides into metabolites which consider less toxic to the environment, and that this time represent the length of the adaptation period of organism, so these organisms play a central role in the biological treatment process (18).

Environmental effect and pollutants :Pesticides cause harm to humans in directly or indirectly through their food, drink, crops and other needs. Insects, worms and rodents such as mice, rats and the like, and parasitic weeds (bush) affect human crops as well as all diseases that affect useful plants (17) and medical statistics indicate to the importance of pesticides to reduce the average of diseases which transmitted by insects such as malaria and other infectious diseases that affect humans and lead to large losses in human lives as well as the economic losses caused by the damage of insect (29). In spite of the important and influential role of Chemical pesticides from different kinds in the past and present, it has saved lives of tens of millions of people in cities, so

it has many positive features (3).

Pollution of the water environment with pesticides leads to human and animal poisoning through drinking contaminated water as well as irrigating crops with it, that cause many negative damages that may lead to the death of those affected by it depending on the dose taken and the in case it used in irrigating again as well as the transmitting pesticides to water organisms which cause water environment pollution with high levels of pesticides which cause dangerous effects on water organisms such as the mass death of fish, birds, invertebrates and species of zooplankton and plants, as well as humans and their economic animals specially when it used in hunting (12). The pesticide reaches to the soil after spraying which effects on the soil living components, as the chemical pesticides which used are compounds whose toxicity varies according to their quality and composition, causing potentially dangerous damage to living organisms and the environment (1). Soil plays an important role as a mediator of materials exchange and energy through the atmosphere, water, biological and rocks, which increase the number of pollutants of the soil (19). Polluted land refers to the condition of the land or soil to which any chemical substance or waste has been added and at levels that increase far from the natural level, which in turn cause harm to the health of all living organisms and various environmental damages (26).

It can be said that the soil is clean when the material is under the environmental concentration in equal concentrations or more minor than the value found in nature, which is used as a reference and is usually called the reference concentration. Reference concentration is total element concentration obtained from soil that didn't affect by human activity, but land in sue procedures in the past; activities in current sites and proximity to pollution sources are all factors that affected soil properties (24).

(31) Mentioned that the sources of pollution in general included atmospheric sedimentation, irrigation with sewage, industrial solid waste collection processes, mining and the use of pesticides and fertilizers, as well as incorrect, insufficient or appropriate waste disposal practices that lead to various forms of pollution (26).

Various human activities added certain substances such as pesticides and fertilizers to the soil and demolition operations along with the processes of grinding and crushing raw materials, which provided a space to the pollution process to occur in the soil, Fossil fuel operations, mining operations, metallurgical industries and various transportation processes redistribute heavy metals that are toxic to the environment (20).

Biodegradation of pesticides :Bioremediation is one of the safest, cleanest, effective and safe environmental treatments for cleaning polluted sites, Various living organisms such as bacteria, yeasts, fungi, algae and plants are used in

treating oil leak, pesticides and heavy metals in the environment to reduce pollution and environmental problems which faced by human (11). The diversity of microorganisms that break up pesticides is widely spread in the water environment and the soil. Their real numbers cannot be known due to the different methods used to examine the presence and enumeration of these microorganisms. Microorganisms have the ability to analyze and dismantle many different chemical compounds, starting with simple compounds such as monosaccharides, proteins and amino acids and fats and others to complex organic compounds such as plant residues, crude oils, waxes and rubber (15), the enzymes which contribute to destroying and dismantling chemical pesticides might be essential enzymes in microorganisms, or may need to be stimulated by pesticides or any chemical factor. It found that thermoactinomycetes have the main enzymes for transmitting Aldrin to Dieldrin pesticide, while the fungus *Fusarium* sp. needs time in order to adapt to the pesticides and then break it up, so few of pesticides will be resisting to biodegradation processes by microorganisms (15), Bioremediation depends on the metabolic of microorganisms to clear or transform a pollutant molecule, which depends on both the accessibility of the contaminant and the bioavailability of the bacteria (21).

Metabolism of pesticides may involve three-stage processes. In the first stage of metabolism, it transfers to raw materials of the original compound through oxidation, reduction or hydrolysis to produce a more water-soluble solution and usually a less toxic product than the original (28), The second stage the conversion of pesticides or pesticide metabolites to sugar or amino acids, which increases water solubility and reduces toxicity compared to the original pesticide. The third stage involves the conversion of the second stage of metabolites to secondary conjugates or compounds. It is also not toxic. In these processes, fungi and bacteria function of cellular or extracellular enzymes, including hydrolytic enzymes, peroxidases, and oxygenases (25).

Types of microorganisms which commonly used in biodegradation: Microorganisms that exist in soil work on organic pesticides decomposition and use them as a source of energy and food. These microorganisms change and break the organic pesticide molecules, which make the efficiency of the pesticide weak. This type of interaction is called microbial degradation, and it leads to the degradation of pesticides and destroys it by the enzymes which exist in them (4). Studies proved that microorganisms are one of the most important factors that lead to the destruction of urea derivatives, especially some types of bacteria such as *Bacillus*, *Xanthomonas*, *Pseudomonas* and some types of fungi such as *Penicillium*, *Aspergillus* which use these compounds as a source of energy. The suitable environmental factors for the activity of these microorganisms such as temperature, humidity, pH and EC, help and make the destruction of the pesticides of this group goes fast (8).

Some studies indicated an increase in the number of microorganisms in soils

that contain large amounts of residual organ chlorine pesticides, and this may happen cause of the benefit that these organisms take from carbon sources that are available in those pesticides. Other studies indicated that organ chlorine pesticides didn't effect on microorganisms in the soil, but it may conclude that there is a difference in the sensitivity degree of microorganisms to different pesticide residues (5).

But other have shown that the numerical density of some microorganisms which exist in the areas contaminated by pesticides may be united or changed, in contrast, others are adapted to live in the presence of toxic substances, and can analyze and use it as food sources. They are not equal in their resistance toward strange substances, while some of it can adapt and grow in contaminated areas. This lead to enlarge the dominance of these organisms by using toxic pollutants and living in it (14).

Most of the herbicides that reach the soil remain close to the treated area in the surface layer in which microorganisms spread that have an important impact on the biological activities which happen in the soil which lead to stopping and killing these organisms, or destroying the chemicals and transmitting them to other compounds (8).

Bacteria are one of the most important components of the biological ecosystem in the soil, they form the main and most spread microorganisms compared with groups of other organisms such as Antinomies, Fungi, Algae and Protozoa (10).

Many microorganisms have the ability to treat biologically according to what was mentioned by previous studies, (22) discovered that two types of Bacillus Spp. Bacteria produce a volatile compound, 2,3-butanediol, which is highly efficient in stimulating systemic resistance against many causes which infect many crops, also is able to encourage plants growth when treated with this compound.

Bacteria B.circulans are involved in producing growth-encouraging factors and intermediate compounds that give natural plant resistance, in addition to stimulating the host and encouraging its growth (20), there are different mechanisms of cooperation with the host, including antibiotic production, colonization and stimulation of systemic resistance.

Also used in the study of cracking (bio treatment) pure farms of Staphylococcus sp. Its positive bacteria, with Gram-G+, is dangerous for humans and contains multiple virulence factors (5).

As for Pseudomonas sp. It is one of the most common Gram - negative bacteria in soil that does not need special nutritional requirements to grow, its known by its great ability to adapt , and consume a range of carbon compounds such as those containing aromatic rings, and this plays an important role in destroying natural and industrial compounds that resist

destroying by other microorganisms, this ability in most cases is made by the enzymes which excreted by the bacteria which live on plasmids in bacterial cell DNA, which are genetic elements outside the chromosome and these plasmids gave the bacteria features making it able to live in extraordinary environmental conditions which able of decomposing pesticides and heavy metals in the environment which they live in (30).

*Aeromonas* sp. includes many kinds known for their pathogenicity to animals, especially amphibians and reptiles, and their pathogenicity to humans. *Aeromonas* sp. Bacteria isolated from soil environment, this bacterium has many effective virulence factors in infecting humans and animals, such as the production of toxins and various enzymes (23), and this bacterium is also distinguished by its production of many plasmids and chromosomal beta-lactamase enzymes, which also makes it resistant to antimicrobials hydrocarbons.

Factors affecting on the biodegradation process :There is a set of operations that determine pesticides destiny in the environment, it works in providing the suitable state of pesticides effectiveness, or converting them to less toxic forms, and these operations are affected by a set of environmental factors that help them convert pesticides into other forms. (13) indicates the stages that the pesticide goes through when it used in the environment, these stages include adsorption, then transition, followed by decomposition, and there are many that factors effect on decomposition process of pesticides, including sunlight, organic matter, moisture, heat, pH, soil texture, and the microbial content of the soil, also the pesticide affected by the factors which mentioned above, and these factors directly and clearly affect all pesticide breaking processes, and it was found that the decomposition process of pesticides by microorganisms affected by a number of factors and decomposition process by microorganisms become very active in warm, wet weather, with ventilated soil and the PH is stable. The biodegradation process with microorganisms by enzymes doubles for every 10 °C increase between 10-45 °C, while the enzymatic activity decreases when the temperatures rise or fall (16).

We note that there is a second effect of temperatures, in certain temperature we notice that pesticide toxicity increased, but when the temperature becomes high or low, we notice a decrease in toxicity and this is what is known negative temperature coefficient, or the heat become responsible on enzymes activity which destroys pesticides and effect on physical and chemical features of pesticide, and the effect of temperature and moisture on pesticides which leads to pesticide decomposition, which may reduce or increase its effectiveness, and then increase the consumed quantities, It also leads to making problems and side reactions to pesticides, especially when it's mixed together, and this reflects pesticide effectiveness or makes its expiration date end fast, or make interactions may occur that increase its toxicity to plants, humans or other organisms that the increase in temperature leads to the transformation of many pesticides to the gaseous state (fast



steaming), which increase air pollution and spread pesticides to farther areas, especially in cities near agricultural areas (9).

Chemical insecticides and are herbicides affected by many physical and biochemical factors, temperature and moisture are the most important factors that affect the effectiveness of insecticides , the insecticides decomposition speed increase with the increase of temperature and the increase of moisture in stored stuff in spite of that this relationship is not always linear, the effect of high or low temperature on the effectiveness of the pesticide may be due to several factors, including those factors related to the pesticide such as pesticide permeability to the insect's body , the increase or decrease in evaporation of the pesticide, and factors related to the pest such as insect activity increasing or decreasing (27), the increasing of moisture decrease pesticides effectiveness and this may happen because of the increase the mixing pesticides with water with high increasing moisture in the soil, causing hydrolysis of the pesticide. Other research confirmed the negative effect of moisture on the effectiveness of pesticides.

pH is very important in agriculture, whether in the cultivation of agricultural crops, alkalinity and acidity specifying, use of added fertilizers, or use water to make spray solutions (consisting of pesticides and water). Now, the effect of pH becomes clear according to the use of pesticides and agriculture fertilizer, the ineffectiveness of pesticides increases when the spray solution is left for hours or a day or more after mixing the pesticide with base water, which means that the effectiveness of the pesticide decreases when the period of mixing pesticide with the base water become long and the time it is sprayed on the crops and when the soil base increases. The researchers noted that the best activity of bacteria in order to analyze pesticides was at pH7. This pH value supports the activity of degrading enzymes compared to the higher and lower values of the pH. Studies indicated that the best incubation period for microorganisms that perform the best biodegradation process for pesticides is between 7-8 days (6).

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