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# Pesticides in the Environment and Mitigation Technologies

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**Abstract**

This widespread use of pesticides for agricultural and non-agricultural purposes has resulted in the presence of their residues in various environmental matrices. The contamination could be on-farm during pesticides manipulation or by wastewaters generated by agroindustrial activities and could be treated efficiently in a biopurification system. This technology with some modifications can be used for treating obsolete pesticides and pharmaceuticals products.

**Keywords:** Biopurification System; Pesticides; Pharmaceuthicals

**Abbrevations:** BPS: Biopurification systems; WRF: white-rot fungi; OTC: oxytetracycline; CFN:carbofuran

## Introduction

The worldwide consumption of pesticides is more than two million tons per year, been Europe the major consumer (>45 %) followed by USA (>25%) and the rest of the world (25%) [1]. Worldwide consumption of pesticides is: herbicides (47.5%), insecticides (29.5%), fungicides (17.5%) and others (5.5%) [2]. The World Health Organization (WHO) states that each year occur in the world's 25 million pesticide poisonings in which 20 thousand people die. On the other hand, the United Nations Food and Agriculture Organization (FAO), reports that while 80% of pesticides spread over the world are used in developed countries, 99% of poisonings occur in developing nations (Figure 1).

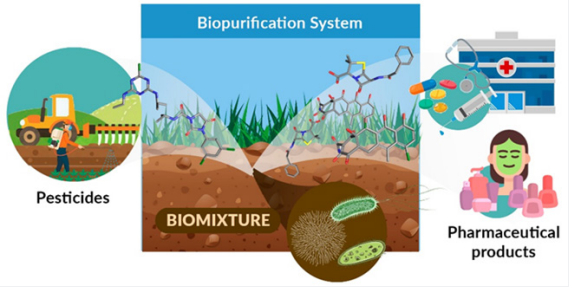


**Figure 1:** Graphical abstract.

Pesticides compounds are toxic chemicals that can adversely affect people, animals, wildlife and desirable plants, besides to target pests [3]. Many of pesticides compounds are hydrophobic or moderately hydrophobic, with a complex chemical composition which makes its degradation in the environment difficult. As a consequence, pesticide residues and their transformation products are frequently found in groundwater and surface waters. The contamination could be during on-farm pesticides manipulation (filling equipment) or by wastewaters generated by industrial activities associated with the agriculture and forestry. Wastewaters from the fruit-packaging industry with high pesticide loads (50-1000 mg L-1) have been reported by Karas et al. [4].

Also, from industries related to manufacturing, packaging, transporting, storing and distribution of pesticides. In manufacturing and formulation and packaging, pesticide wastewaters can be generated from formulation equipment cleanup, spill wash-down, drum washing, air pollution control devices, area runoff and laboratory drains [5]. On-farm, pesticide residues remain in the containers and application equipment after pesticides are applied to target areas. These residues are removed by rinsing with water resulting in the formation of a toxic wastewater that represents a disposal problem for many farmers. Another important source of pesticides contamination is the production of forbidden and expired pesticides [6]. Obsolete pesticides are defined as pesticides that have been banned, they are chemically damaged, outdated, that are unknown or have fallen into disuse.

Globally, the amount of obsolete pesticides exceeds 500 thousand tons and of these about 30 thousand tons are in Latin America (International Bank for Reconstruction and Development, (2010). Biopurification systems (BPS) were developed to reduce the environmental pollution due to on-farm point-source contamination mainly caused by spilling or washing water from pesticide application equipment's [5,7]. Also, for the treatment of agroindustrial wastewaters containing pesticides [5,8].

They are based on adsorption and degradation processes on a biomixture, formulated with soil, peat and straw or agro-industrial residues and eventually inoculated with pesticides-degrading microorganisms [9-13]. Rodriguez et al. [14] summarize the potential participation of white-rot fungi (WRF) in BPS and describe the enzymatic systems involved in pesticides degradation. Besides, the authors present an outline of BPS, focusing on the elements that influence the participation of WRF in their operation and studies regarding the fungal-mediated degradation of pesticides in BPS biomixtures.

## Discussion

Several studies have demonstrated that BPS can effectively retain and degrade pesticides [7]. Niels et al. [15] evaluated the degradation and leaching of 21 pesticides and they determined than no traces of 10 out of 21 applied pesticides were detected in the percolate. The BPS has been tested to degrade a mixture of pesticides with repeated applications with high efficiency and has been demonstrated that > a 90% of the products were degraded in the BPS, decreasing the half-life of the products compared with their degradation in soils [16,17].

Recently, the BPS has been used as a new alternative to treat wastewater contaminated by emergent contaminants. These compounds are potentially harmful for humans and ecosystem. We can mention, pharmaceutical products, drinking water and swimming pool disinfection products, sunscreens and UV filters, flame retardants, benzothiazoles, etc. [18]. In this sense, Jimenez et al. [19] studied the capacity of the system to dissipate oxytetracycline (OTC) in a biomixture previously used for carbofuran (CFN) removal obtained that different doses of OTC did not significantly affect CFN mineralization. They concluded that this biomixture can be re-use as a support material for wastewater treatment of this type of contaminant. Similar behaviour was found by Cambronero et al. [20], who employed a fungal pre-treatment of OTC rich wastewater, before its disposal in a BPS used for the treatment of two pesticides. They demonstrated a high efficiency of the biomixture to remove pesticides, and indicate that the fungal pre-treatment of OTC containing wastewater was not required before its disposal in the BPS.

## Conclusion

The biopurification system is an adequate and efficiently technology to degrade complex molecules of pesticides in single and repeated applications. This technology can be used efficiently to treat emerging contaminants along with pesticides in an unique system, preventing soil and water contamination.

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