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Microbiological and Physicochemical Quality of Polluted Water with Pesticides in Ben M'hidi (North Eastern of Algeria)

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ABSTRACT

For many years, the pesticides used in agriculture are responsible for environmental degradation, particularly noticeable in the areas of intensive agriculture, particularly through contamination of surface and ground water. Our study was conducted to isolate and identify the micro flora of water polluted by pesticides in an area with agricultural vocation (Ben M'Hidi) subject to the pesticide effect for several years. Isolated fungal strains were identified based on the morphology of their vegetative and reproductive apparatus. The micromycetes were obtained; they belong mainly to the genera *Aspergillus, Penicillium* and *Trichoderma*. Furthermore, most bacterial strains, characterized in this work is that of the genus *Aeromonas*, *Pseudomonas* that are widely represented in the study of the biodegradation of pesticides.

1. Introduction

The use of pesticides or plant protection products has improved yields and crop diversity to meet the nutritional demand linked to the crossing of the world population. However, this use has also resulted in indirect and adverse effects on the environment. In addition, contamination of ground and surface waters [1-3].

These toxic chemicals have become an integral part of the ecosystem. Since these substances are chemically designed to act as a poison against, pests (target species) [4].

One of the major environmental consequences of the current intensive agriculture is the degradation of water quality. This degradation leads to surface waters like groundwater by pollution related to the dissemination of agricultural inputs such as plant protection products, inorganic nitrogen and phosphate fertilizers or livestock manure. Pesticides can easily penetrate the soil and water sources. Different authors have shown contamination of pesticides in surface water and deep pools of wine [5, 6].

The surveys of farmers and dealers have helped to give an overview of the pesticides in Algeria, whose use is low compared to developed countries. The most commonly used pesticides in Algeria are fungicides and insecticides in contrast to developed countries where herbicides occupy the first place [7].

This work is a contribution to the development of physicochemical and bacteriological quality of water polluted by pesticides by the evolution of a number of physico-chemical parameters and bacteriological listed above.

2. Experimental Methods

2.1 Sample Collection

The study concerned the agricultural areas situated in the northeastern part of Algeria (BEN Mhidi) where is the vegetable crop (tomato, potato, pepper and corn). Water samples were taken at different locations in the study area in glass containers; transport to the laboratory of the sample bottles were carried out in a low-temperature cooler (4 °C) [8, 9].

2.2 Culture and Isolation of Stem

Selected culture media are malt extract agar, Potato Dextrose Agar (PDA) Sabouraud and Czapek. Equipment and media used for culture are sterilized by autoclaving at 120 °C for 20 minutes.

Purification is carried out by successive subcultures on agar medium of a small cutting thallus or few spores. The fungal species were identified using specific key [10, 11] based on their cultural characters and macroscopic morphology observed under microscope.

The isolated bacterial strains are purified by successive subcultures on Muller-Hinton medium. After studying the morphology, gram staining and study of physicochemical properties using the API 20 E and API galleries nE 20, identification is performed by web API digitized software (Api web Biomérieux France).

2.3 The Physicochemical Analyzes

pH, electrical conductivity are determined using a multi-parameter analysis Type CONSORT-Model 835. For the BOD5 COD analysis. Methods are followed which are recommended by Rodier (1976).

3. Results and Discussion

3.1 Physicochemical Water Analysis

The electric conductivity refers to the ability of water to conduct an electric current and is determined by the content of dissolved substances, the ionic charge, the ionization ability, mobility and the water temperature. Therefore, it provides information about the degree of mineralization of water. The values of the electrical conductivity of studied water is above 1000 µS/cm, so this water is highly mineralized (Fig. 1).

The pH of the water measures the concentration of the protons H contained in the water. It summarizes the stability of the balance between the different forms carbonic acid and is linked to the buffer system developed by carbonates and bicarbonate [12]. Fig. 2 shows that the pH is between a minimum of 6.80 and a maximum of 7.72 which is close to neutral.

However, it should be noted that pH values less than 5 or greater than 8.5 affect the growth and survival of microorganisms. The decrease in pH resulting from the activity of bacterial decomposition of organic matter.

Concerning the chemical oxygen demand COD and after Fig. 3, the results clearly show that the S5 site presents the minimum value (15 mg/L) and the site of important value S6 (38.33 mg/L) lower the standard 40 mg/L.

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BOD5 translates the amount of molecular oxygen used by microorganisms during a 5 day incubation period at 20 °C to decompose the organic material, dissolved or in suspension, contained in one liter of water. According to Chapman et al [13], BOD5 natural water is less than 2 mg/L. Waters receiving domestic discharges have concentrations above 10 mg/L. Studied waters showed relatively high values BOD5 (Fig. 4). These strong values are linked to a strong oxidation of oxidizable inorganic compounds. In addition, they are attributable to contamination of water from the alluvial aquifer by the Sebou containing wastewater rich in organic matter.

The Fig. 4 shows that the values of BOD5 recorded are between 2.63 mg/L at S1 and 5.20 mg/L at S3. It is clear that the concentrations of BOD5 are well below the standard (30 mg/L). This shows us the existence of a biological treatment.

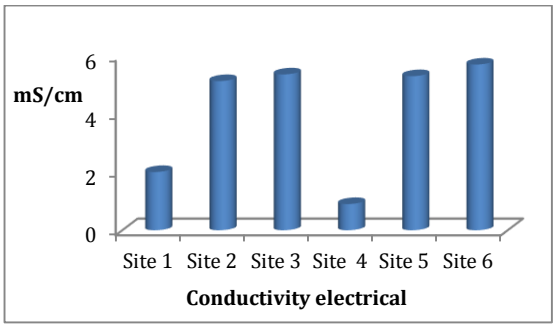

Fig. 1 Conductivity electrical values recorded of water samples

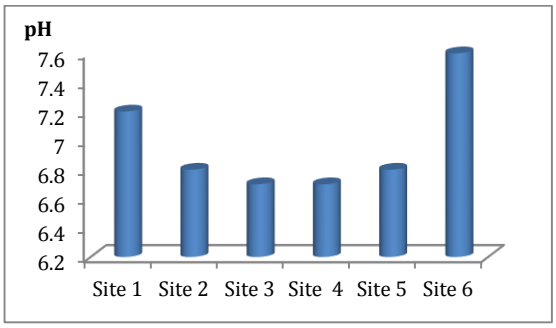

Fig. 2 pH values recorded of water samples

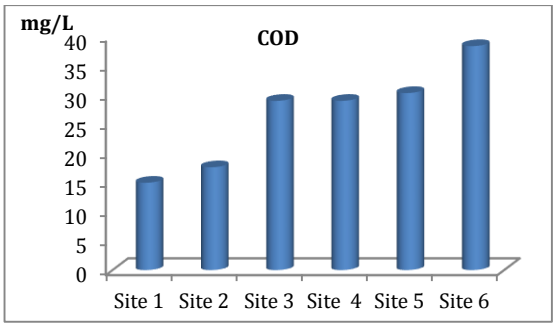

Fig. 3 COD values recorded of water samples

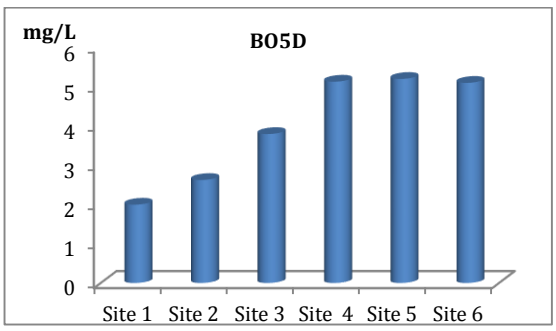

Fig. 4 BOD values recorded of water samples

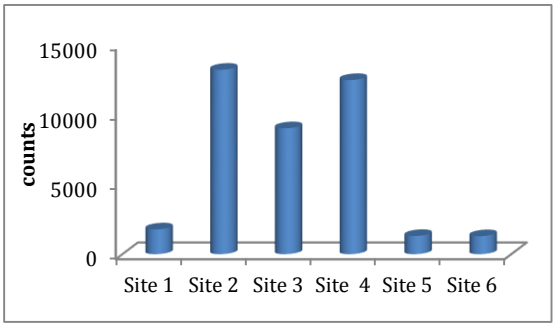

Fig. 5 The total fungal density sample sites

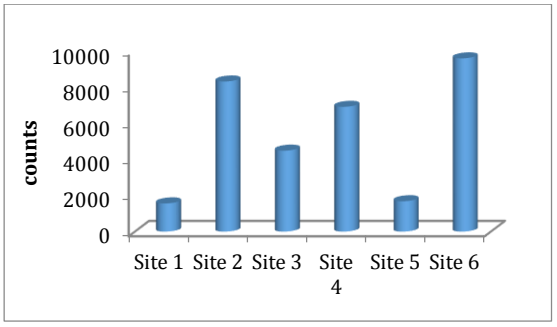

Fig. 6 The total bacterial microflora sample sites

3.2 Microbiological Analyses

The study of the microflora of the waters of the studied sites, allowed us to obtain a microbial flora equal to 71695 strains (Figs. 5 and 6). Composed of 32521 bacterial species belonging to several families and 39174 fungal species. Distributed over all the samples of the waters of which the most predominant are classified in the family of *Aspergellus*. Their frequency is rather heterogeneous according to the nature and the place of sampling.

As regards the microbiological analysis, the isolated strains were identified based on the morphology of their vegetative and reproductive apparatus. Micromycetes 10 species have been obtained; they belong mainly to the genera *Aspergillus, Penicillium* shown in Table 1.

Table 1 The list of identified fungal species

Champignons	Champignons
Aspergillus niger	*Penicillium chrysogerum*
Aspergillus versicolor	*Penicillium citreonigrum*
Aspergillus flavus	*Penicillium notatum*
Aspergillusfumigatus	*Trichoderma viride*
Aspergillus terreus	*Rhizopussp*

Reading the results galleries API 20 NE, allowed us to identify 10 bacteria that can grow in an environment polluted by pesticides under specific conditions, shown in Table 2.

Table 2 The list of the identified bacterial microflora

Bacteries	Bacteries
Aeromonas hydrophila	*Pasteurella Pneumotropica*
Aeromonas salmonicida	*Pseudomonas aeruginosa*
Chryseomonas luteola	*Sténotrophomonas maltophilia*
Chryseobacterium meningosepticum	*Serratia marcescens*
Moellerella wisconsensis	*Burkholderia cepacia*

4. Conclusion

This work has the purpose of making a diagnosis of bacteriological and physico-chemical state of surface waters in an agricultural vocation region (Ben M'Hidi) subject to the pesticide effect to do this, an evaluation of the physical characteristics-chemical water was determined. Analyses focused on the conductivity, pH, EC, COD and BOD.

The results obtained from the physico-chemical analysis, it appears that the agricultural runoff is quite polluted by toxic substances such as pesticides.

The species surveyed are one hand, a list of microorganisms that can survive in the particular conditions of heavily contaminated substrates by the presence of several herbicides, fungicides and toxic compounds releases from various industrial facilities. On the other hand, species living

in untreated environment from pesticides, these non-acclimatized species are generally sensitive to the effects of toxic substances and their difficult conditions. Isolated fungal and bacterial populations are diversified in the majority of specimens; they belong to different classes and especially marked by the presence of numerous *Aspergillus, Penicillium*, *Trichoderma*, *Pasteurella*, *Pseudomonas* and *Aeromonas*. They are resistant to various pollutants and suffer high levels of herbicides.

Among all these dominant species in this mycoflora, the most predominant is *Aspergillus niger*. It is high frequency isolated in all study sites this is in perfect agreement with the previous reported results.

Moreover, the presence of pathogenic bacteria, such as *Burkholderia cepacia, Pseudomonas aeruginosa, Pasteurella pneumotropica* and *Aeromonas hydrophila* let assume that we are in the presence of contaminated environments. However, these media are a biotope biological degradation or biodegradation is possible since these two bacterial species are highly regarded in the field of bioremediation of different pollutants.

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