

EFFECT OF THE USE OF WASTEWATER PURIFIED ON THE BIOFONCTIONNING SOILS

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Abstract

The objective of this study is to estimate the impact of the use of wastewater purified on the abundance of macro invertebrates and the physical and biochemical modifications in the cultivated soils of Corso, Boumerdes, north Algeria. The study is led, in field conditions, during the wintry rest, on little reshaped grounds. Twenty grounds were sampled in two vineyards, the first one irrigated with unchittered waste water, the second drives in pluvial conditions (witness). The physical and chemical parameters of grounds, as well as the enumeration of the invertebrates of grounds according to the method of Berlèse-Tullgren on two levels (L1: 0-10 cm et L2: 10-20 cm) were measured. Soils have a limon-sandy texture, with a slightly acid pH, variable organic rates of limestone and carbon from a soil to another one, with an electric conductivity raised in the handled soils. Fifteen wildlife groups were listed, with variable abundances from levels and soils. Hymenoptera, Annelids and arachnids are the most plentiful abundance in located in the first ten centimeters for all grounds.

Key words: treated wastewater, macro invertebrates, soil, vineyard

1. INTRODUCTION

In the Mediterranean regions the hydric stress is a major environmental problem. The use of wastewater could be a solution. At present time the situation in Algeria is characterized by an increasing demand in water while water resources become scarce in a permanent way particularly for the agriculture. The use of handled wastewater appears as a first answer at this situation of shortage (Condom and al., 2012). In the early 2000, Algeria launched the project of purge and use of wastewater in the irrigation of some cultures by creating centers of purification named O.N.A., (2003) through all the territory. The soil pollution, the subterranean waters and the surface is the most important inconvenience of the use of handled wastewater. The deficiencies in the management of wastewater remain one of the main factors of transmission of the diseases and the degradation of the environment (Pescod, 1992 ; Vassel, 2007). Indeed, we grant not much importance for the cover of the services of purification compared with that of the services of water supply, and even less with the purge (Hartani, 2004). This has an impact on the biological diversity of the ecosystems which establishes a good indicator of their quality and their capacity to resist the changes due to the external factors. Among the bio-indicators of the balance of grounds our interest concerned their fauna. The disappearance or the appearance of a sort, the modification of its relative abundance, the modification of the structure of the animal communities of an ecosystem are so many indicators which can mean modifications of the environment. These indicators must be quantified to document the improvement or the degradation of the earth quality (Pernin, 2003). Soil invertebrates are characterized by their abundance, their diversity and their distribution. They participate in the recycling of organic matters and play a role in the creation and the preservation of the structure of the ground (Lavelle and Spain, 2001). Most of the sort of invertebrates are in the first centimeters of the ground where the concentrations in organic matter and in roots are the highest (Bardy et al., 2010). For that purpose, the strategy of the reuse of handled wastewater was discussed with the aim of exploiting this consideration resource in irrigation by taking into account requirements of healthiness.

In the farming sector, this reuse is a technique which offers an additional valuation of water resources while protecting the environment (Coineau, 1974). This study returns within the framework of a problem concerning the preservation of the object of a presentation of the qualitative and quantitative variations of the communities of invertebrates of grounds in contact with the physical and biochemical

characteristic of studied grounds led by handled wastewater, this is the aim of studying the impact of the use of these waters on the abundance of invertebrates and the evaluation of the fertility of these soils.

2. MATERIAL AND METHODS

2.1. Site description

The study was conducted on five sites in Corso north Algeria, but only the results of two stations are presented in this work. Main characteristics of the sites are presented in table 1. Annual rainfall equal 900 mm and ETP (Thornwaite) 1073 mm. The region of study is under Mediterranean climate, in the bioclimatic floor subhumide moderated with a dry period which extends of the end May until in the middle of October. Two plots of land belonging to the same lithotoposequence were chosen as the sampling of grounds (26°45'35.87''N, 3°25'45.33''E). The first one is a vineyard irrigated with uncluttered wastewater, the second is a vineyard of the same age (10 years) not irrigated as we consider as witness. The irrigation is made by means of a simple said system named the system of drip. This region is lined by outcrops of base of type granite, close to coast it are red sands of the very compact upper pliocene which appear and recover marls (Askri, 2009).

2.2. Soil sampling and characterisation

The sample was made in January 2012. We conducted a sampling diagonally ten vineyard soils. Soil characteristics were determined on ten replicates from the composite samples according to standard methods proposed in Jackson (1967). Particle size distribution was measured according to the Robinson pipette method (*i.e.* organic matter oxidation by H₂O₂, shaking in a sodium hexametaphosphate solution). Soil pH was measured in a 1/5 soil distilled water suspension. The CaCO₃ content was determined using the HCl 1M volumetric method. Organic C was determined by sulfochromic oxidation. Electrical conductivity was measured in a 1/5 soil distilled water suspension.

2.3. Invertebrate sampling and identification

Invertebrate sampling was carried out in winter (January) 2012, following the methodology outlined in Coineau (1974). In each selected vineyard, ten sampling zones of 25 x 25 cm, at least 20 m distance from each other, were set up. Two depth profiles were sampled at each sampling site. Large invertebrates were then hand-sorted in the laboratory. Remaining invertebrates were then extracted from the soil using the Berlese-Tullgren method (Pesson, 1971). After extraction, all invertebrates were preserved in 70° alcohol for later identification. Due to the still currently very incomplete taxonomic catalogue of Algerian soil fauna, invertebrates were only identified to order level in most cases. Taking account of their social behavior and the resulting aggregated distribution, ants were analyzed separately from other macro-invertebrates. Hence, total density referred to the density of all macro invertebrates but excluding micro and meso invertebrates.

2.4. Statistical analyses

The Kruskal-Wallis rank sum test was used for looking at soil differences vineyard. Afterwards, multiple comparisons were done to identify groups that differed (Siegel and Castellan, 1998). We also tested for the influence of the wastewater their actions on both the overall population density and the diversity of invertebrates. For this, analyses of variance were performed on log-transformed data. Tukey's 'Honest Significant Difference' method was used to test for multiple comparisons of means.

3. RESULTS AND DISCUSSION

3.1. Description of soils

Soil characteristics are detailed in Table 2. The texture of grounds is limono-sandy, with a slightly acid pH. No differences in pH. Rates of limestone of 6,8 for the irrigated plot of land and 4,43 for the plot of land witness. The organic carbon is low around 0,3% for the witness around 0,84 % for the irrigated ground. Soils are salted with an electric conductivity raised in the irrigated ground.

3.2. Abundance of macro invertebrates

The group of Ants is significantly the most plentiful followed by the most present Dipters in L2 followed by larvas of Coleopters which are more plentiful in L1. Other groups are little or not plentiful. Annelids are little plentiful what can be bound to the negative effect of the plowing. Ants established the group the most representative as in the first plot of land follow up of Coleopters. Other groups are weakly plentiful to see even absent.

3.3. Discussion

The abundance of macro invertebrates in the studied grounds and in both levels can be explained by the work of the ground, the water of irrigation and the level of taking in particular for the plot of land irrigated as well as the plant place setting and the season of sampling. The dominance of Ants in these grounds and in both levels is due to their speed of multiplication to the availability of a food potential and perhaps to their preference in vineyard (Culliney, 2013).

We notice that Snails are strongly present with regard to the other groups in particular in the irrigated grounds, it is due to their abundance in the soils which have a good retention in water (Davet, 1996). Pterygotes are little plentiful, it is due to the seasonal effect. The other groups practically every consumers of the organic matter are weakly plentiful, it is due to the effect of the competition and the predation (Gobat et al., 2003). The analysis of variance shows that the factor level is significant only for Earthworms, Isopodes and Hymenopterans in the irrigated plot of land. It is not significant for the wildlife groups of the other grounds.

The analysis in component main watch of the correlation between the wildlife groups and the factors edaphics. Soil fauna participates in the degradation of the organic matter and attack almost all the plant fragments (Hedde and al., 2006). Coleopters play an important role in the fragmentation of the organic matter whereas feed on roots and plant fragments [(Gobat et al., 2003; Hedde, 2006).

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Table 1. Characteristics of the studied sites.

	EUE	Witness
Altitude (m)	25	25
Mean annual precip. (mm)*	900	900
Mean annual temp. range (°C)*	6.29 - 33.9	6.29 - 33.9
Vineyard age (yr)	10	10
Slope	1%	1%
Type (WRB)	Cambisol	Cambisol

Table 2. Mean (standard error) soil characteristics of the studied vineyard.

Grove	EUE	Witness
pH water	6.67 (0.08)	6.72 (0.1) ns, B
Org C (%)	0.84 (0.03)	0.30 (0.05), A
CaCO ₃ (g kg ⁻¹)	6.81 (0.08)	4.43 (0.05) ns, B
CE (ds/m)	0,26 (0.02)	0,09 (0.01), A
Clay (%)	40.65 (1.15)	34.70 (0.84), AB