Biomonitoring of Soil Quality
By Soil FAUNA

Sabino A. Bufo[1], *Patrizia Falabella*[2], *Laura Scrano*[3] *and Simona Laurino*[2]

[1] Department of Science and [2] Department of European Cultures, via dell' Ateneo Lucano 10, University of Basilicata, Potenza, Italy

sabino.bufo@unibas.it

INTRODUCTION

The awareness of the problems related to soil pollution, in heavily populated areas, has led to a growing interest in the soil fauna study; the biological quality of the soil through the soil fauna is, to date, one of the most approved methodologies. Furthermore, is also known in the literature its importance as biomarker. Its use as a biomarker is due to the dissimilar capacity of different organisms to adapt to unfavorable environmental conditions caused by human activity [1]. Human disturbance causes the disappearance of most sensitive organisms with consequent alteration of the ecosystem. The soil fauna organisms perform the entire life cycle in the soil and are more susceptible to disturbances than other organisms linked to the soil only for a short period of their life cycle. For this region, they can be seen as important indicators of environmental quality. Analyses were carried out as part of the environmental monitoring inside the farm "Il Querceto" (Italy), characterized by both forest and agricultural areas. The aim was to verify the evolution of some biological characteristics of the farm's soil concerned by the burial of an underground pipeline. The monitoring of soils was performed by using the index of Biological Quality of Soil (QBS-ar) proposed by Prof. Vittorio Parisi (University of Parma); it is based on analysis of all groups of microarthropod in the soil (insects, arachnids, myriapods, crustaceans) [2].

MATERIAL AND MHETODS

The changes in the populations of some microarthropod groups (Acari, Oribatei, Diptera, Pauropodi, Collembola, Isopods, Annelids, Coleoptera, Hymenoptera) in relation to different conditions of each soil have been analyzed. A different score, corresponding to stated numerical values, defined Ecomorphological index (EMI), has been attributed to each biological form. Each microarthropod group in the soil sample receives an EMI score from 1 to 20, according to its adaptation to the soil environment. The QBS index is the sum of EMI scores; the underlying concept is that soil quality is positively correlated with the number of microarthropod groups that are well adapted to soil habitats [3]. Thus, the QBS index is a measure of how well the soil fauna adapt to the particular soil conditions. This study has been performed in 4 steps: Sampling; Extraction of soil fauna; Analysis of soil fauna; Calculation of QBS-ar-class quality.

Sampling

Figure 1: Sampling sites.

The soil sampling, to perform the extraction of the edaphic fauna and the analysis of the QBS-ar, is a delicate stage. You need to choose adequately the sampling sites in order to obtain reliable results. 9 different sites were chosen, according to the representative of the area to be monitored, identified as A1P1 (blank, 698m above sea level, land use: Forest), A2P1 (stony site, *Medicago sativa* L., land use: Forest), A3P1 (*Medicago sativa L.*, land use: Forest), A4P1 (*Medicago sativa* L., land use: Forest), A5P1 (land use: Agriculture), A6P1 (land use: Agriculture), A7P1 (land use: Agriculture), A8P1 (638m above sea level, land use: Agriculture), A9P1 (very compact soil, pasture/horses, 678m above sea level, land use: Agriculture). For each site were carried out three replicated (Fig. 1), each sample (size 10x10x10 cm) was placed in a plastic bag and labeled (date, site name, number of replicated). The samples collected were taken to the laboratory for analysis.

Extraction of soil fauna

The extraction of soil fauna was performed using a Berlese-Tullgren selector (Fig. 2); it consists of a funnel, a light source, a screen, and a receptacle into which the animals fall. A small lamp with a low-power light bulb (10-40 Watts) heats and dries the soil from above. This causes the soil animals to fall through the sieve into a container with a preservative (usually 75% alcohol). The process is ended when the soil is dry this generally takes 7-10 days depending on the condition of soil humidity.

Figure 2 Berlese-Tullgren selector.

Analysis of soil fauna

The analysis of edaphic fauna was conducted by examining the organisms present in the preservative liquid, using a SMZ800 NIKON stereomicroscope with magnification between 10X and 80X (Fig. 3A and 3B).

Figure 3: A) Stereomicroscope; B) Observation of the sample by microscope.

Calculation of QBS-ar-class quality

EMI SCORE									
Organisms/sites	A1P1	A2P1	A3P1	A4P1	A5P1	A6P1	A7P1	A8P1	A9P1
Protura								20	
Collembola	1	4		20	6	2			
Psocoptera			1	1				1	
Hemiptera	1	1		1	1	1		1	
Thysanoptera	1	1		1	1			1	
Coleoptera			5						
Hymenoptera	5	1	1	1	1				1
Diptera (larvae)	10	10	10					10	10
Other holometabolous (larve)	10	10	10	10	10	10	10	10	10
Other holometabolous (adults)	1	1	1	1	1	1		1	1
Opilionidi		10							
Araneida	1	1		1	5				1
Acari	20	20	20	20	20	20	20	20	20

In this table was reported the macro- and micro fauna in soil samples and their EMI score.

RESULTS AND CONCLUSIONS

Based on the EMI sum of each sample was extracted the QBS of the specific site. The total value of QBS-ar for each station, allowed us to divide the soil into separate classes characterized by growing environmental quality. From the results obtained, the total values of QBS-ar calculated and its class of soil quality for each sample are shown on the adjacent table.

In this specific case the QBS-ar allowed to discriminate the impact of oil pipeline in both the forest and agricultural areas.

Sites	QBS-ar	Class
A1P1	50	4
A2P1	59	4
A3P1	48	6
A4P1	56	4
A5P1	45	4
A6P1	34	4
A7P1	30	2
A8P1	64	6
A9P1	43	4

References

[1] Fogliati L., Nicola A., 2013. Il biomonitoraggio del suolo.

[2] Parisi V., 2001. La qualità biologica del suolo, un metodo basato sui microartropodi. Acta Naturalia de L'Ateneo Parmense 37, 97-106.

[3] Codurri M., Truzzi A. e Bertonazzi M. C., 2005. Microartropodi del terreno: manuale da campo per il riconoscimento dei microartropodi del terreno come indicatori della qualità biologica del suolo (metodo QBS-ar), Calvatone, Consorzio del Parco Naturale dell'Oglio Sud.