

Evaluation on the Innovative Plan on Environmental Biomonitoring Using Biotic Indicators

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Abstract

The general objective of the research is to realize a new innovative plan of environmental biomonitoring based on terrestrial arthropods and mainly the Bees for air and macro-invertebrates for the contamination of the fluvial environment. The specific objectives were: i) improve the procedures for zero-impact environmental biomonitoring; ii) inserting natural and non-artificial biondicators into the production cycle; iii) improve monitoring through innovative systems based on biotic agents; iv) improve the cross-company competitiveness of the Company in the reference sector. The project falls within a basic research (conception and conceptualization) and an experimental development (design and prototyping) partly carried out in 2018, and which will see a final part in 2019.

Keywords: bees, innovative, process, monitoring, environment.

1. Introduction

In recent years, monitoring with bees has taken on greater importance due to its characteristics of managerial simplicity, cost-effectiveness and greater detection efficiency compared to fixed control units. The bees, in fact, are able to reveal the health of the environment for a range of up to 3 km from the location of the survey stations. Environmental pollution and the recent emergencies associated with poor

land management (e.g. dioxin, hexachlorocyclohexane, neonicotinoids) in recent times have also echoed in public opinion. In particular, the need to monitor the environment that surrounds us more closely for the purpose of protecting it and detecting sources of pollution are very topical issues. Bees, industrious insects par excellence, belonging to the Apidae family, subfamily Apinae and Apini tribe, live in colonies of about 35,000 - 50,000 individuals. The bees are excellent biological indicators because they signal the damage of the environment in which they live, through two signals: the high mortality in the case of insecticides and through the residues that can be found in their bodies, or in the products of the hive, in the case of non-toxic pesticides and other pollutants such as heavy metals and radionuclides. Many ethological and morphological characteristics make the bee a good ecological detector: it is easy to breed; it is an almost ubiquitous organism; does not have large food requirements; its body is covered with hair that makes it particularly suitable for intercepting materials and substances with which it comes into contact; it is highly sensitive to most pesticide products (in particular insecticides) which can be detected when they are improperly spread in the environment (for example during flowering, in the presence of spontaneous flora, in the presence of wind, etc.); the high rate of reproduction and the average life span, relatively short, induces a fast and continuous regeneration in the hive; it has a high mobility and a wide range of flight that allows you to control a large area; makes numerous daily withdrawals; inspects all environmental sectors (land, vegetation, water, air); it has the ability to bring back various external materials into hives and to store them according to controllable criteria; need for extremely low management costs, especially in relation to the large number of samples taken.

2. Materials and methods

The Ecosantagata S.r.l. plays its role as manager and custodian of the environment with responsibility and awareness of the centrality that this role has in the future of people and the territory. The goal towards which we are heading is to create shared value for the territory and for all those who live and inhabit it. This is why we have engaged in numerous projects that involve local stakeholders and stakeholders with three main aims:

- share with the local community a portion of the revenues generated by the management of the storage site by using them in projects with a public purpose;
- spread the environmental culture and the waste cycle;
- support and incentivize the social, cultural and economic growth of the territory.

One of the ways to deal with the territory is to support its socio-cultural development, the well-being and health of citizens.

The phases of project are:

- Identification of new combinations of existing functions with new functions (product and / or process innovation).
- Identification of new combinations of technologies for process improvement (process innovation).

- Definition of new production techniques that combine lower costs with higher quality.
- Balancing between organizational innovation and technological innovation to be acquired.
- Information on the performance of the technologies and their impact on quality and construction cost
- Decisions relating to the outsourcing of activities or components to suppliers and partners
- Support the competitive analysis of the product in terms of technologies and functions compared to competitors
- Support a client-centered strategy while guaranteeing high quality product conditions.

The Plan is divided into biological monitoring activities with the aid of:

- terrestrial atropods: European bee colonies (*Apis mellifera* L.), sentinel and bio accumulator species for certain contaminations present in the environmental matrices air, water and in the soil / plant systems;
- aquatic macroinvertebrates indicating contamination of the river environment (water and sediments).
- The biomonitoring took place through hives equipped with sensors and data transmission systems belonging to the Company, using the "underbasket" method (Accorti et al., 1991b), with one intervention per month during the beekeeping season. Furthermore, samplings were performed for aquatic and macro-invertebrate stations per season (indicative periods, actual dates based on weather conditions), including sediment sampling (if present).

3. Discussions and Conclusions

The start of the activities envisaged by the Biomonitoring Experimental Plan of the area concerning the non-hazardous waste management plant of Ecosantagata S. r. l., took place in perfect consistency with the provisions of the Plan itself. In particular, the success of the Experimental Apiary plant is underlined with the positive result of the incorporation, albeit late, of the 6 colonies of Italian bee (*A. mellifera ligustica*) treated by a Bee Entrepreneur identified by Ecosantagata S.r.l. The empirical evidences reported by the Beekeeping Entrepreneur following the checks, were in line with the experimental evidences acquired through the automated systems for collecting data of the hives from which a normal average weight variation pattern emerged, a good flight activity in favorable weather conditions and a thermal hive regime compatible with bee colonies in good general condition. As evidence of this, the quantities of dead bees collected using underbasket traps, arranged in apiary on a monthly basis, were found overall to be limited, although significant differences were observed between the hives and between the sampling dates. This suggests that these events cannot be directly linked to the level of impact generated by the management of the plant which,

although predictable on the basis of the Environmental Impact Assessment (Ecosantagata, 2015), does not seem to have been realized during most of the checks carried out. In this circumstance, in fact, a more homogeneous situation should have occurred between the six Experimental Hives. Experimental Apiary are available for possible analytical insights on the accumulation of unwanted substances such as heavy metals, persistent organic contaminants and other substances to be identified on the basis of the chemical-physical checks for the matrices envisaged in general audit plan of Ecosantagata S.r.l. In light of the experimental results of the first two checks carried out (summer and autumn), waiting to have a more complete picture based on the results of the controls scheduled for the winter 2018/2019 and spring 2019, the impact of the management activities of non-hazardous waste at the Ecosantagata S. r. plant on the whole of the biotic components examined, terrestrial arthropods (managed colonies of *Apis mellifera* L.) and aquatic macroinvertebrate fauna, was overall modest and in any case confined to space and / or time. These preliminary conclusions are in any case to be validated during the continuation of the activities in the Convention until their natural expiration.

Acknowledgements. This study was supported by the BIOBEE 4.0 project. **Ideation** of the project by Di Giovenale Leonello, Riganello Stefano, **Conceptualization** by di Giovenale Leonello, Riganello Stefano, Di Giovenale Ilenia, Riganelli Beatrice, **Planning and Prototyping** by Di Giovenale Leonello, Riganello Stefano, Di Giovenale Pamela, Di Giovenale Ilenia, Riganelli Beatrice, **Technology transfer** by Roberto Bedini.

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Received: April 15, 2019; Published: May 15, 2019