The Sound of the Soil

"Listening" to what happens in the soil to better understand the health of the vineyard: this is the objective of soil ecoacoustics

by**MARIA LUISA DOLDI**

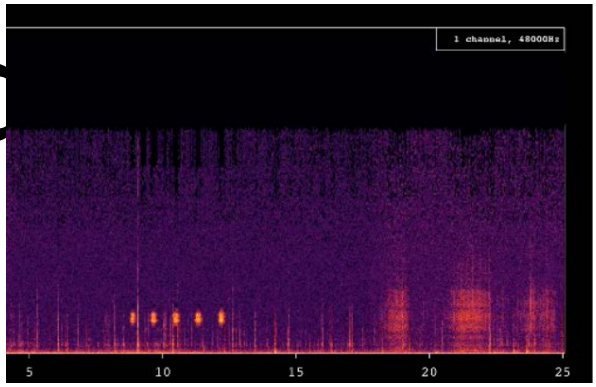
The report *The State of Soils in Europe*, published in 2024 by the Joint Research Centre of the European Commission and the European Environment Agency, paints a far from reassuring picture. Some 24% of European soils are subject to erosion, with an estimated loss of around one billion tonnes of soil every year. Some 74% of agricultural land suffers from nutritional imbalances, and between 2009 and 2018 European soils lost around 70 million tonnes of organic carbon. For a long time, soil remained the Cinderella of modern agriculture and attention focused mainly on everything that happens above the surface. Very little attention was paid to what happens underground. Yet it is precisely there, in the sub-surface layers of the soil, that many of the challenges facing viticulture play out: resilience to climate change, water availability, fertility, biodiversity and the capacity to maintain the long-term productivity of vineyards.

THE SHIFT

A change is now under way: soil health has become a firm priority on the European agricultural agenda. EU Directive 2025/2360 on soil monitoring and resilience — which entered into force on 16 December 2025 and must be transposed into national law within three years — requires Member States to establish soil-health monitoring systems with the aim of improving soil health and achieving land-degradation neutrality by 2050. Meanwhile, the spread of regenerative and organic farming has already multiplied demand for tools capable of measuring what is happening in the soil: not only from a chemical and physical standpoint but also in terms of living organisms. It is in this context that the work of Soil Acoustics comes in — a British company that developed a new technology launched on the market in July 2025: soil ecoacoustics.

LISTENING TO UNDERGROUND BIODIVERSITY

Chemical and physical analyses are undoubtedly an indispensable tool for assessing soil health, but today there is broad scientific consensus that a healthy soil is also a living, vibrant soil, rich in living organisms. And it is here that a new frontier of analysis and measurement opens up, proposing a radically different approach: listening to the soil and to the sounds of the living communities within it. From this insight soil ecoacoustics was born — a discipline that applies soundscape analysis to underground ecosystems. A frontier still little known in agriculture and viticulture, but one that is beginning to attract the attention of researchers, agronomists and companies engaged in regenerative soil management. Among the key players in this emerging field is the British company Soil Acoustics, which in July 2025 launched the Soil Acoustic Meter (SAM), a portable instrument designed to measure the biological activity of the soil through sound. A technology still in its infancy — on the market for just over a year — but one that is already finding application in various agricultural contexts, including some European vineyards.



Spectrogram of a biologically active soil. The bright traces represent acoustic events generated by organisms living in the soil and form the basis of the Soil Acoustic Quality Index (SAQI)

The operating principle is surprisingly simple. A probe is inserted into the ground and records for a few minutes the sounds produced by organisms living in the surface layers of the soil. Worms, beetles, arthropods, ants and other invertebrates generate vibrations and micro-sounds as they move. The device captures these signals and converts them into analysable data.

Once the recording is complete, the data are uploaded to an online platform. Processing returns an index called the SAQI (Soil Acoustic Quality Index), built on the basis of the abundance and diversity of the recorded sounds. “We are not only interested in measuring how noisy the ground is,” comments Baker. “An ant colony can produce a lot of noise but represent only one species. What we are trying to measure is the biological richness of the soundscape.” The aim is not to identify every single species present — at least for now — but to obtain a synthetic measure of the overall biological activity of the soil.

AN ADDITIONAL ANALYSIS, NOT A REPLACEMENT

One point must be made clear from the outset: SAM does not replace traditional agronomic analyses. It does not measure pH, nutrient availability, cation exchange capacity or organic matter content. It provides no direct information on the physical structure of the soil or its microbiological composition. Rather, it adds a dimension that is often missing from routine monitoring: that of real-time biological activity.

“We see this technology as another piece of the puzzle,” says Baker. “Chemical and physical analyses remain fundamental. We provide different information, linked to the biological activity of the soil and its evolution over time.”

In this sense, acoustic data represent a new way of interpreting the situation, not a definitive answer. The question the system poses is not “which nutrients are present?” but rather: “how alive is this patch of soil?”