Young reporters for the environment

International collaboration Turkey and Spain

Article -15-18 years

IZMIR PRIVATE CAKABEY HIGH SCHOOL and COLEGIO SANTA MARİA VILA-REAL

The main theme of this study is to promote sustainable agriculture by converting organic waste into valuable resources to improve food security and protect the environment.

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Students: İzmir BARIŞCAN, Duru Naz KIRBEYİ, Ali Baray ÖLÇER, Yiğit Kaan GÜLDAĞ, Egemen ŞAHIN, Mar Oquendo LLORENS, Adriana Romero ALBALAT, María Morcillo MIURA, Sergi Fernández REDÓ, Marc Adell MIRÓ

Mentors: Viki CALDERON- Dilce İNANÇ- Özge DOĞAN – Sezgin ONUR - Sisco MARCO

Title of the submission: SUSTAINABLE VERMICOMPOST PRODUCTION FROM CITRUS WASTE AND ITS IMPACT ON SOIL FERTILITY

Rapid urbanization and the Green Revolution have increased environmental waste and dependence on chemical agriculture (Ngoc & Schnitzer, 2009). Citrus production in Mediterranean countries like Spain and Turkey generates millions of tons of waste annually, emphasizing the need for sustainable recovery solutions (FAO, 2017; Baysal, 2014; Tridge, 2024; Türkiye Tarım Orman Bakanlığı, 2025).

Soil organisms, particularly the California red earthworm *(Eisenia fetida*), play a key role in improving soil fertility, structure, and nutrient cycling (Ateş & Coşkan, 2016). Organic fertilization enhances soil quality, reduces chemical dependency, and supports environmental and human health (Özkaya, 2021). Our study focuses on producing vermicompost from citrus waste as a sustainable, practical, and eco-friendly solution for organic waste management.

SUSTAINABLE VERMICOMPOST PRODUCTION FROM CITRUS WASTE AND ITS IMPACT ON SOIL FERTILITY: THE ROLE OF RED EARTHWORMS

This study is directly aligned with the United Nations Sustainable Development Goals, including Goal 2 (Zero Hunger), Goal 12 (Responsible Consumption and Production), Goal 13 (Climate Action), and Goal 15 (Life on Land). The Young Reporters for the Environment program, which encourages young people to understand environmental challenges and develop solution-oriented projects, brought together students from Spain and Turkey around these shared values. İzmir Private Çakabey High School (Türkiye) and Colegio Santa María Vila-real (Spain) conducted a joint project entitled *"Sustainable Vermicompost Production Using Citrus Waste: Effects on Soil Quality and Structure."* Students from both countries also aimed to contribute to their countries' commitments under the European Green Deal by sharing their projects with the wider public.

In this joint study conducted by schools from two countries, tasks were divided between the groups. The Turkey group focused on producing vermicompost from citrus waste and investigating its effects on sustainable waste management and soil fertility, while the Spain group evaluated the impact of red earthworms on soil fertility by comparing worm-amended soil with a non-amended control.

What Are Vermiculture and Vermicompost?

Long-term use of chemical fertilizers degrades soil structure, disrupts nutrient balance, and reduces soil fertility and beneficial microorganisms (Brady & Weil, 2017). Vermicompost is an environmentally friendly organic fertilizer produced through vermiculture, where earthworms decompose organic waste to support sustainable agriculture. The red Californian earthworm (*Eisenia fetida*) is widely used in vermiculture due to its adaptability and high capacity to consume organic matter (Edwards et al., 2011). During digestion, organic materials are broken down by enzymes and microorganisms, while calcium carbonate helps regulate pH and nutrient transformation. As a result, vermicompost improves soil properties and promotes plant growth (Domínguez & Edwards, 2011).

Preparation for the Experimental Setup by Çakabey High School

Figure 1. In the figure, you can see our experimental work, the sensors used, our earthworms, and the Munsell color analysis results of the soil samples.

The experiment was conducted over 10 weeks in temperature-controlled containers under monitored conditions. Two groups were established: a control group and an experimental group receiving 1 kg of citrus waste weekly. Each container included 40 kg of soil, 300 earthworms equally distributed, regular irrigation, and controlled temperature (18–25 °C). Ventilation systems and low-heat lighting ensured optimal living conditions and continuous earthworm activity. Environmental parameters, including soil moisture, temperature, and pH, were monitored and recorded every 2–3 days using sensors (Product name: Digital Soil Detector with Display (LY-201)).

Preparation for the Experimental Setup by Colegio Santa María Vila-real

Under the same experimental conditions as the other school, the experimental group was established using 7 kg of soil, 400 g of dried orange waste, and 200 earthworms of various sizes. In the other container, 7 kg of soil and 400 g of dried orange were used for a control group.

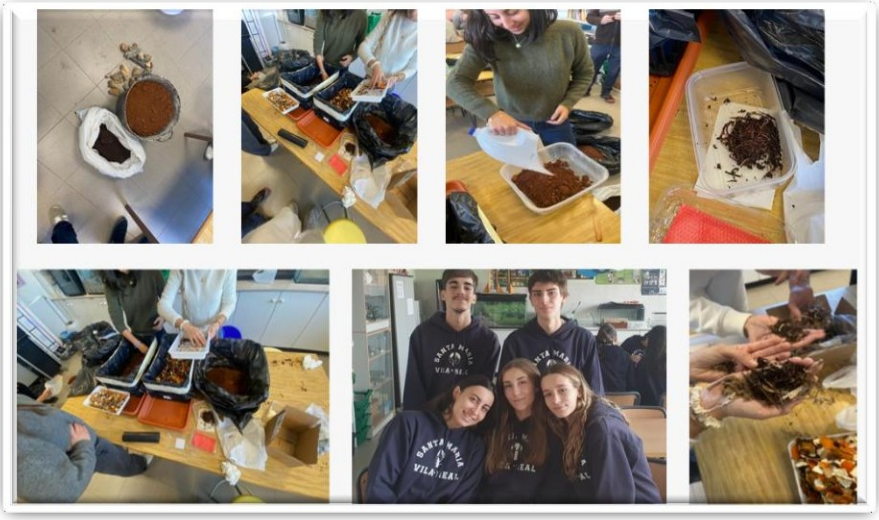

Figure 2. In the figure, you can see the soil materials used, our experimental work, our earthworms, and the Spanish team.

Results and Discussion

The results obtained by İzmir Private Çakabey High school showed that the experimental group treated with citrus waste had improved soil properties and increased earthworm activity compared to the control group. The experimental soil exhibited higher moisture stability, a shift toward neutral pH, and more stable temperature conditions. Munsell color analysis indicated darker soil tones in the experimental group, reflecting improved soil quality (Figure1). Laboratory analyses confirmed increases in organic matter, carbon, and nitrogen levels, indicating enhanced soil fertility and active decomposition processes. Earthworm digestion and calcium carbonate secretion helped neutralize pH, enabling the effective transformation of citrus waste into nutrient-rich soil (Bano, 2001; Yu et al., 2022; Atiyeh et al., 2000).

The results obtained by Colegio Santa María Vila-real highlight the effects of earthworm activity on soil properties. Both soil samples showed slightly alkaline pH values within the optimal range for plant growth. The worm-amended soil exhibited higher electrical conductivity and improved nutrient availability. Increases in organic carbon and organic matter indicated enhanced biological activity and soil structure. Nitrogen levels were slightly higher, while nitrate and potassium remained consistently high in both samples. A significant increase in phosphorus content suggested improved nutrient mobilization due to earthworm activity. Nutrient ratios and secondary elements remained stable, indicating preserved soil chemical balance. Overall, earthworms contributed to soil fertility mainly through biological enhancement and nutrient cycling.

By employing *Eisenia fetida* as a biological processing agent, this research evaluates the transformation of citrus residues into nutrient-rich vermicompost and examines its effects on soil quality, structure, and color characteristics. The findings of this study provide scientific evidence supporting the role of vermicomposting as a key strategy in promoting circular economy practices, reducing environmental pollution, and enhancing soil health. Furthermore, this research contributes to the development of sustainable agricultural systems by offering a scalable model for converting agricultural waste into high-value organic fertilizer.

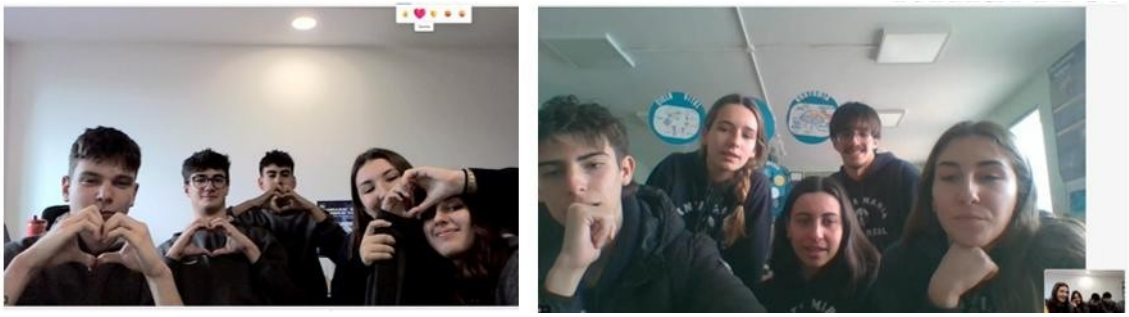

Figure 3. Joint meeting of Turkey and Spain

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DISSEMINATION

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