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CHEMISTRY DIDACTICS

Studying the importance of soil organic matter: An educational proposal for secondary education

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Abstract Although the importance of including in the curriculum of all educational levels issues related to soil science has been strongly highlighted, the fact is that the importance that the quality and availability of organic matter in the quality of soil have received very little attention when it comes to considering educational practices in classrooms. This paper brings an educational proposal for teaching the transcendence of organic matter in soil at secondary level. The learning unit presented is based on essential chromatography techniques and allows the qualitative study of soil organic matter. The ultimate purpose is to offer basic educational tools for reflection on the implication that soil has in order to maintain biodiversity and food production.

PALABRAS CLAVE
Métodos de enseñanza;
Educación de pregrado;
Ciencia del suelo;
Educación secundaria

Estudiando la importancia de la materia orgánica del suelo: una propuesta educativa para educación secundaria

Resumen Aunque la importancia de incluir en el plan de estudios de todos los niveles educativos cuestiones relacionadas con la ciencia del suelo ha sido fuertemente resaltada, el hecho es que la importancia de la calidad y la disponibilidad de la materia orgánica en el suelo han recibido muy poca atención cuando se consideraran las prácticas educativas en las aulas. Este documento aporta una propuesta educativa para la enseñanza de la trascendencia de la materia orgánica en el suelo en el nivel secundario. La unidad de aprendizaje presentada se basa en las técnicas esenciales de la cromatografía y permite el estudio cualitativo de la materia orgánica

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del suelo. El objetivo final es ofrecer herramientas educativas básicas para la reflexión sobre la implicación que tiene el suelo a la hora de mantener la biodiversidad y la producción de alimentos.

Introduction

Soil is a complex, non-renewable and essential natural resource in the maintenance of ecosystems and it is also key to ensuring the food, energy and fibre supply to humans.

Soil organic matter comes from either the remains of living things which were once alive or their waste products in a natural environment. Once on the ground, organic matter undergoes a set of complex chemical transformations conducted by living beings in soil (Trevors, 1998). Thanks to these chemical changes, organic matter gradually achieves a quasi-equilibrium state known as *humus* which can remain stable over time (Schmidt et al., 2011; Tan, 2014).

What makes humus so important for plant life is that it is rich in humic and fulvic acids. These substances produce organo-mineral associations with ions such as Mg^{2+}, Ca^{2+}, Fe^{2+} y Fe^{3+} (Tang et al., 2014) resulting in an increase in the availability of micronutrients to plants which is an essential feature of healthy and fertile soils.

However, secondary and high school level educational programs have paid little attention to this crucial factor closely tied to soil productivity (Bertha & Leslie, 2002; Megonigal et al., 2010; Vila, Contreras, Fernández, Roscales, & Santamaría, 2001).

Objective

On the basis of the above, this paper presents a practical proposal specially targeted for the laboratory of secondary education with the purpose of encouraging a vision of soil organic matter as a finite and vulnerable resource which is essential to sustain plant life, the environment and to the foodstuffs industry.

Procedure

The following is the teaching sequence proposed to achieve the previously highlighted objective. To this end, and as a form of an example, this paper presents a real study carried out with five soil samples.

First step: sampling and sample preparation

The five soil samples analysed in this study were collected using a metal trowel to a depth of 10 cm.

First of all, the samples are left to air dry for three days on a white blank sheet of paper. Then, 150 g of each soil sample is taken, without stones or plant debris and are sieved and ground with a mortar until a homogeneous powder is achieved. The final samples, duly sieved and ground, are stored in clearly labelled paper bags.

Second step: the impregnation of the stationary phase with light-sensitive substance

To continue with the experiment Whatman qualitative filter papers (grade 4) are required. In this case, 5 circular filters are to be used, one for each sample. With a pencil, two points will be marked on each filter, 4 and 6 cm respectively from the centre of the circle.

On another development, five small pieces of filter paper are cut (2 cm $\times$ 2 cm) and these filter pieces are rolled up to form small cylinders as a cannula or tiny tube. Finally, a hole is drilled into the centre of each filter and each of the previously created cannula is inserted perpendicularly through the holes in the centre of each filter.

The filter with the cannula lodged in the centre is placed on a Petri dish in which previously a 0.5% silver nitrate ($AgNO_3$) solution is poured (see Fig. 1).

The dissolution will rise by capillarity through the cannula, soaking into the filter paper. When the dissolution reaches the previously marked point (4 cm from the centre of the filter), the filter is removed from the Petri dish. Finally the cannulas are removed from the filters and these are left to dry. To this end, the filters are kept separately between sheets of paper and inside a dark box so that the silver cannot be reduced by light.

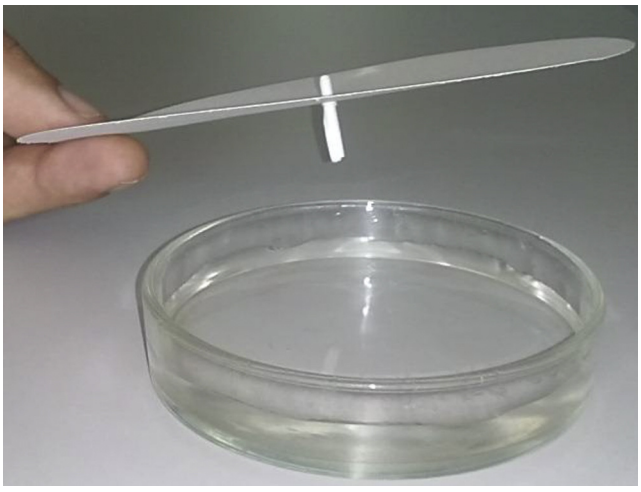

Figure 1 The impregnation process of the filters with $AgNO_3$.