Developing an integrated approach to enhance soil fertility and favour recarbonization of Mediterranean agricultural soils: a case study from Valencian Region in Spain

Garcia-Rández, A.[1], Pérez-Murcia, M.D.[1], Fernández-Suarez, M.T.[1], Sánchez-García, F.[1], Agulló, E.[1], Bustamante, M.A.[1], Andreu-Rodriguez, J.[2], Barber, X.[3], Roselló, J.[4], Cháfer, M.T.[5], Moral, R.[1]

[1]Dpto.Agroquímica y Medio Ambiente, Univ. Miguel Hernández, EPSO-Orihuela, Ctra. Beniel Km 3,2, 03312-Orihuela (Alicante)
[2]Dpto. Ingeniería, Univ. Miguel Hernández, EPSO-Orihuela, Ctra. Beniel Km 3,2, 03312-Orihuela
[3]Dpto de Estadística, Matemáticas e Informática, Univ. Miguel Hernández. Avda. Universidad s/n, 03202 Elche (Alicante), España.
[4]Servicio de Producción Ecológica, Innovación y Tecnología. Estación Experimental Agraria de Carcaixent, Partida Barranquet s/n, 46740. Carcaixent. Valencia
[5]Dirección General PAC. c/ Castán Tobeñas, 77, Ed. B4, 2ª. 46018. Valencia

PROYECTO DE INVESTIGACIÓN Y EXPERIMENTACIÓN EN COMPOSTAJE

AgroCompost

Introduction

Figure 1: Composting:

Agriculture, livestock and agri-food sectors in Mediterranean countries have a wide amount of waste fluxes including significant waste-diversity to produce balanced and high-quality composts not only to reconstruct C stock, but also to rebuilt soil properties to increase resilience of agricultural soils against erosion, water shortages and others.

Figure 2: Turning and control of the composting process

Mediterranean countries are the most sensitive to climate emergency in terms of the sustainability of agri-food sector. **Agrocompostaje project** is been developed in Valencia Region (2017-active now) to generate the driving forces to produce a model change oriented to recarbonization of agricultural soils using several approaches but especially mulching and co-composting.

This project includes monitoring, quantification and analysis of organic waste fluxes, development of co-composting pilots with actors, optimizing of co-composting mixtures in km 0 and low cost settings, monitoring of the process and quality assessment of final compost with agronomic advisement.

Results & Discussion

More than **300 different sources of organic wastes** from agriculture, livestock and agri-food sectors in the Valencian Region have been analyzed.
A very **powerful database has been elaborated** to identify the opportunities for managing these organic matter pools and especially the nutrients included into these mass fluxes to be reoriented to agricultural soils.

Property	Agricultural origin (n=151)	Livestock origin (n=114)	Agri-food origin (n=90)
Water content (%)	39.7 (1.0-94.6)	39.4 (11.2-71.8)	50.9 (7.9-93.8)
Bulk density (t/m³)	0.249 (0.015-0.88)	0.37 (0.12-0.83)	0.523 (0.05-1.25)
pH (1:10 extract w/v)	6.6 (4.3-9.3)	7.7 (6.1-9.4)	6.5 (5.0-8.4)
Electrical conductivity (1:10 extract w/v)	4.01 (1.0-36)	5.85 (2.1-16.7)	4.34 (1.16-12.3)
Organic matter (%)	81.7 (40.5-97.1)	70.3 (28.9-89.9)	82.7 (48.6-96.7)
Organic C (%)	42.2 (25.1-66.1)	36.5 (18.5-46.9)	45.4 (29.1-61.5)
C/N ratio	37.5 (10.5-115)	24.0 (7.8-122)	33.0 (9.0-110)
Total N (%)	1.55 (0.5-3.7)	2.12 (0.79-4.29)	1.90 (0.56-4.78)
Total P (g/kg)	2.88 (0.25-16.9)	6.1 (1.1-25.8)	3.87 (0.19-21.9)
Total K (g/kg)	18 (3.9-57)	26.3 (6.4-81)	21 (5.1-49)
Total Na (g/kg)	6.9 (0.21-111)	7.8 (0.3-19.3)	4.21 (0.4-13.8)
Water-soluble polyphenols (mg/kg)	8541 (572-66826)	5695 (768-16644)	5951 (1116-12455)

Figure 3. Average composition of the Valencian Region wastes

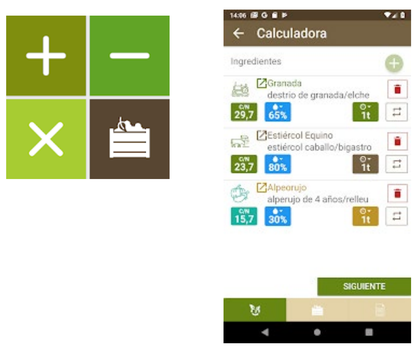
Agricultural and agri-food wastes **are slightly acidic and mainly organic (>80%). Livestock wastes in Valencia are alkaline, salty and rich in P.** A significant presence of water-soluble polyphenols was found in all the samples.

To produce optimized **co-composting** mixtures oriented to obtain balanced compost more than **160 different processes have been developed.**

Property	Nº samples	Average (range)
Water content (%)	89	43.0 (8.0-80.5)
Bulk density (t/m³)	89	0.488 (0.196-0.842)
pH (1:10 extract w/v)	95	8.3 (6.7-9.8)
Electrical conductivity (1:10 extract w/v)	95	3.98 (1.08-17.2)
Organic matter (%)	95	49.2 (21.4-86.2)
Organic C (%)	95	28.4 (9.92-45.2)
C/N ratio	95	14.9 (6.77-41.3)
Total N (%)	95	2,07 (0.66-4.32)
Total P (g/kg)	94	7.50 (0.92-27.0)
Total K (g/kg)	95	18.4 (2.6-74.7)
Total Na (g/kg)	95	7.04 (0.44-22.5)
Water-soluble polyphenols (mg/kg)	95	1396 (149-4867)

Figure 4 summarizes all these co-composting processes in **an averaged/ideal compost produced into our region,** able to be used to calculate the re-carbonization and nutrient recovery capacities

Figure 4. Average composition of developed composts in Agrocompostaje program in the Valencian Region



The results of the project include sectorial solutions (wine, olive oil and horticrops sectors), with validated recipes to produce and use **advanced compost**.
A powerful knowledge platform (www.agrocompostaje.edu.umh.es) has been developed including a composting calculator as an open access app, **©CompostCalculator by UMH.**

Conclusions

The knowledge acquired with **Agrocompostaje** project allows the construction of **optimized composting guidelines**, which constitute the basis of good agricultural practices **for sustainable management of key waste streams from the Valencian primary sector**. Likewise, organic-compost amendments of high quality, good nutrient content and value-added properties are obtained in situ. In this way, there is an **increase in organic carbon in the soil**, which favors the **resilience of the soil-plant systems**, improving the hydrophysical, physical, chemical and biological properties of the soil.