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Towards “zero waste”: new agricultural techniques for a more sustainable horticulture

Increasing the use of compostable and biodegradable materials in agriculture

Interreg Mediterranean REINWASTE

Project co-financed by the European Regional Development Fund

DEFINITIONS

Bellow, some key conceptual definitions:

Biodegradable: a material is considered biodegradable when, given the proper conditions and the presence of certain microorganisms, it can eventually decompose and be transformed into its basic components. As a result, there is a biochemical simplification of the material’s molecules, as well as the mineralization of its carbon into CO2.

Compostable: a compostable material is always biodegradable, but this concept also implies that the material degrades in a certain time and under certain conditions. The official quality certifications that regulate the standard materials have developed a series of tests and reference levels that certify and verify wether a material is or not compostable. Aditionally, these are technical rules which are not mandatory.

Mulching: it consists of covering the floor with different materials (usually plastics). The main objective is to raise the temperature of the soil around the plant so that the roots are in better conditions for its proper development. Some of the benefits of this technique are: (i) increasing yield and precocity, (ii) weed control, (iii) soil water conservation, (iv) improving efficiency of soil disinfection methods.

Tutoring: it is an agricultural technique that consists of providing support to the crops with twines (commonly called raffia), rings and clips in order that plants can grow properly. Among other benefits of this technique, we can mention: (i) increasing air circulation through the foliage, (ii) lifting of the plant avoiding that the fruits and flowers are in contact with the soil, limiting in this way fungi diseases, (iii) prevention of damage by trampling during field work.

In Almería, the most important economic activity is based on intensive greenhouse horticulture. It is a key sector and pioneer worldwide in terms of technology and efficiency of resources and inputs. Currently, there are more than 35,000 ha in production under intensive horticulture, which produced 3,525,187 tons of horticultural products in the 2018-2019 season.

For this area, it is estimated that 90,738 t and a volume of 187,049 m3 of inorganic waste are generated annually (see table). The maintenance of the roof structure (43.22%) and the plastics used for disinfection (23.21%) are the productive functions with the highest percentage of inorganic waste generation (Sayadi et al., 2019).

Function	Weight		Volume	
	(Tm)	%	(m^3)	(%)
Greenhouses	39,214.87	43.22	49,798.19	26.62
Substrates	1,219.17	1.34	1,598.33	0.85
Water storage	575.67	0.63	729.53	0.39
Disinfection	21,061.26	23.21	24,065.64	12.87
Shading	9.80	0.01	10.48	0.01
Transplanting	697.75	0.77	40,714.11	21.77
Tunnels	2,259.25	2.49	2,428.52	1.30
Padding	4,900.13	5.40	5,064.98	2.71
Supporting system	6,447.66	7.11	4,890.78	2.61
Irrigation	4,966.50	5.47	20,760.13	11.10
Plant protection	4,033.75	4.45	17,333.23	9.27
Pollination	2,469.26	2.72	26.04	0.01
Harvesting	2,883.20	3.18	19,629.66	10.49
Total	90,738.27	100	187,049.61	100

THEMATIC

In general, with regard to the composition of the generated waste, the 94% correspond to organic residues and the rest (6%) to inorganic waste. Additionaly, the 5.3% of weight inorganic fraction in intensive horticulture of Almeria corresponds to polypropylene, which pose big difficulties in the management of organic waste. The main reason is that composting plants reject plant material containing traces of polypropylene raffia. Likewise, the problem related to mulching plastics lies in the difficult acceptance of them by waste management plants, since these materials are often in bad condition and accompanied by sand, dust and vegetable waste, therefore needing high conditioning before being processed.

OBJECTIVES

In order to solve this problem and framed with the REINWASTE project, other more environmentally sustainable materials for mulching and tutoring have been tested as alternatives to the materials traditionally used such as low-density polyethylene and polypropylene, respectively.

SOLUTIONS PROVIDED BY REINWASTE PROJECT

To address the above-mentioned problem, 5 pilots have been selected and implemented in horticultural greenhouses. Each pilot is composed of several alternative solutions, which are compared with the conventional practice and are the following:

1. Use of alternative materials for plant staking raffia (see photo):

- Conventional practice: Use of polypropylene raffia.
- Alternative 1: Use of reusable raffia.
- Alternative 2: Use of 100% plant origin (jute) 100% compostable.
- Alternative 3: Use of biodegradable raffia (mixture of plant origin and a polymer).

2. Use of alternative materials for plastic mulching (see photo):

- Conventional practice: Use of low-density polyethylene mulching.
- Alternative 1: Use of compostable plastic mulching.
- Alternative 2: Use of in-soil biodegradable plastic mulching.

3. Energetic valorisation of difficult-to-manage waste:

- Conventional practise: Use of conventional waste management channels.
- Alternative 1: Valorisation by gasification.

4. Application of documentary traceability to waste management:

- Conventional practice: Use of common documentary traceability control systems.
- Alternative 1: Use of a hard-copy (physical) based documentary traceability system.
- Alternative 2: Use of a telematic traceability software.

5. Comparison of different associative waste management levels:

- Conventional practice: Individual farmer waste management.
- Alternative 1: Agreements farmers' association with several waste management companies.
- Alternative 2: Agreement farmers' association with a unique management company.
- Alternative 3: The farmers' association becomes waste manager.

PILOT TESTS IN HORTICULTURAL GREENHOUSES OF ALMERÍA (SE SPAIN)

CHALLENGES

- The challenges to achieve by the testing of these alternative solutions horticultural practices, are the following:
- Reduction of specific inorganic waste tons.
- Improvement of production.
- Reduction of production costs.
- New commercial opportunities and quality products attributes.
- Reduction of the environmental impact.

A, Tomato plant skated with conventional raffia (polypropylene); B, Tomato plant skated with jute raffia; C, The three tested skating raffia (polypropylene, jute and mixte); D, Alternative tested mulching (compostable and in-soil biodegradable).

REFERENCE

Sayadi S, Rodríguez CR, Rojas F, Parra C, Parra S, García MC, García R, Lorbach MB, Manrique T. 2019. Inorganic waste management in greenhouse agriculture in Almería (SE Spain): towards a circular system in intensive horticultural production. Sustainability 11, 1-16. https://www.mdpi.com/2071-1050/11/14/3782/htm

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