Innovative Eco-Technologies for Resource Recovery from Wastewater

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Innovative Eco-Technologies for Resource Recovery from Wastewater

INCOVER

Deliverable D3.6

INCOVER case-study 1

Work Packages 3

Added-value resources production

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Executive summary

Deliverable D3.6 describes the Case-Study 1 validated at TRL 7-8. This deliverable consists of a photo gallery of each technology and global view of the CS1.

1. Photo gallery of case-study 1

Case study 1 has been implemented in the Agròpolis experimental campus of Universitat Politècnica de Catalunya (UPC), Viladecans (41.288 N, and 2.043 E UTM). This location is close to Barcelona's airport, in the North-East coast of Spain.

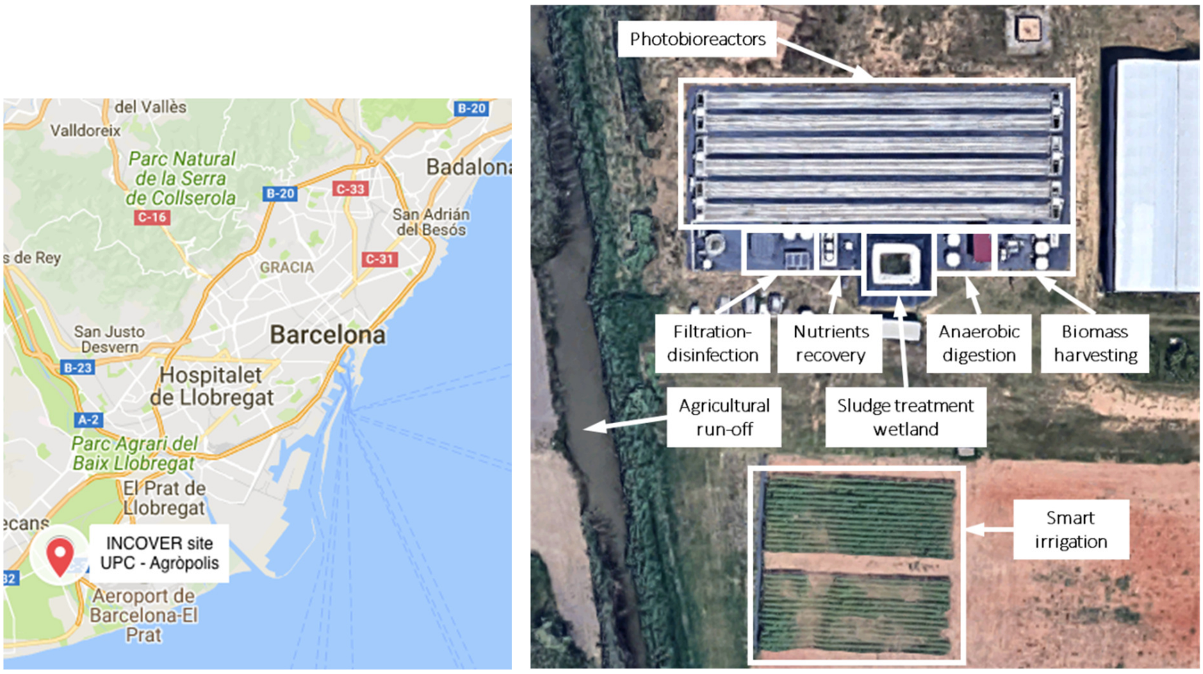

Figure 1. Location map of Case Study 1 (left) and top view of unit processes in Case Study 1 (right).

A comprehensive diagram of the processes and technologies implemented in Case Study 1 is shown in Figure 2. The main processes and technologies are:

- Cyanobacteria/bacteria production in photobioreactors (PBRs).
- Biomass harvesting in a lamella settler.
- Thermal pretreatment and anaerobic (co-)digestion of the biomass.
- Biogas upgrading in an absorption column.
- Digestate valorization in a sludge treatment wetland.
- Effluent post-treatment in a solar-driven ultrafiltration and disinfection system.
- Nutrient recovery in adsorption columns with sol/gel coated materials.
- Smart irrigation using the reclaimed water.

A photo gallery of all these processes and technologies is presented in the following.

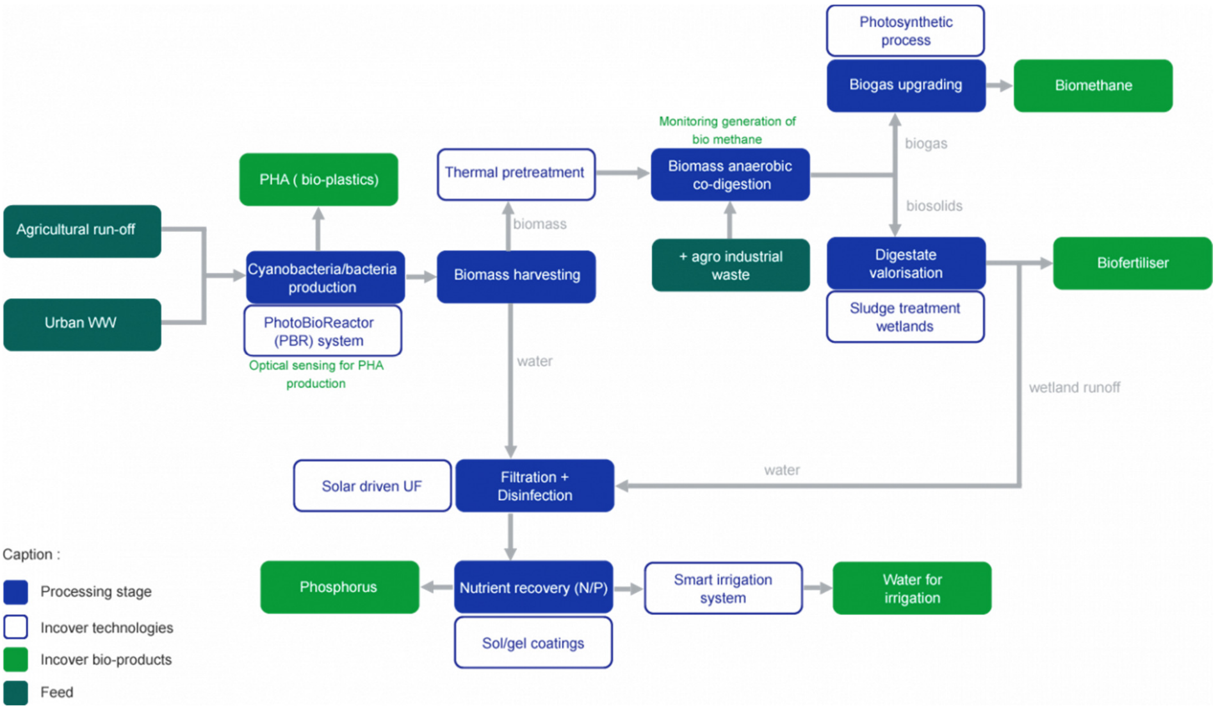

Figure 2. Diagram of the processes and technologies implemented in Case Study 1.

A global view of the facilities in Case Study 1 is shown in Figure 3 (front), Figure 4 (side), and Figure 5 (back).

Figure 3. Global view of the facilities implemented in Case Study 1 (front view).

Figure 4. Global view of the facilities implemented in Case Study 1 (side view).

Figure 5. Global view of the facilities implemented in Case Study 1 (back view).

The influent wastewater, composed of agricultural run-off and domestic wastewater, is mixed in a 10 m^3 polyethylene homogenization tank (Figure 6).

The set of three PBRs (11.7 m^3 each) is shown in Figure 7. The lateral open tanks, where the paddle wheels are installed, and the mixed liquor with microalgae, are more visible in Figure 8.

Figure 6. Tank for mixing and homogenization of the influent wastewater.

Figure 7. View of the three photobioreactors.

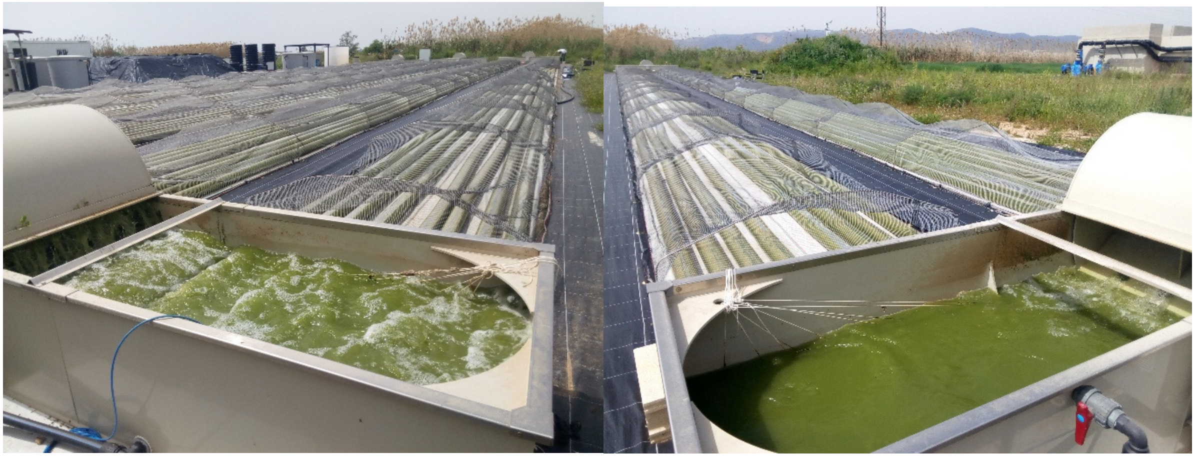

Figure 8. View of the lateral open tanks of the photobioreactos.

The microalgal biomass is harvested in a lamella settler made of polypropylene with a total volume of 700 L (Figure 9). A side view of the settler is shown in Figure 10. After harvesting, the biomass is further thickened in two gravity thickeners with a volume of 200 L (Figure 11).

Figure 9. Lamella settling tank for biomass harvesting.

Figure 10. Side view of the lamella settling tank.

Figure 11. Gravity thickeners.

The anaerobic (co-)digestion plant is shown in Figure 12. Its main elements are the tank for thermal pretreatment of the microalgal biomass (more in detail in Figure 13), the anaerobic digester of 800 L made of stainless steel, and the biogas storage tank (1 m^3 gasometer).

Figure 12. Anaerobic (co-)digestion plant: pretreatment (left), anaerobic digester (middle), and biogas storage tank (right).

Figure 13. Tank for thermal pretreatment of microalgal biomass.

The biogas produced during anaerobic (co-)digestion is upgraded to biomethane in a 45 L absorption column with a height of 4 m (Figure 14). The absorption column was located between the anaerobic (co-)digestion plant (close to the gasometer) and the third PBR, as shown in Figures 14 and 15.

Figure 14. Absorption column for biogas upgrade to biomethane.

Figure 15. View of the biogas upgrading column, located between the anaerobic (co-)digestion plant and the third photobioreactor.

The digestate from the anaerobic (co-)digestion was further stabilized and dewatered in a sludge treatment wetland, shown in Figure 16.

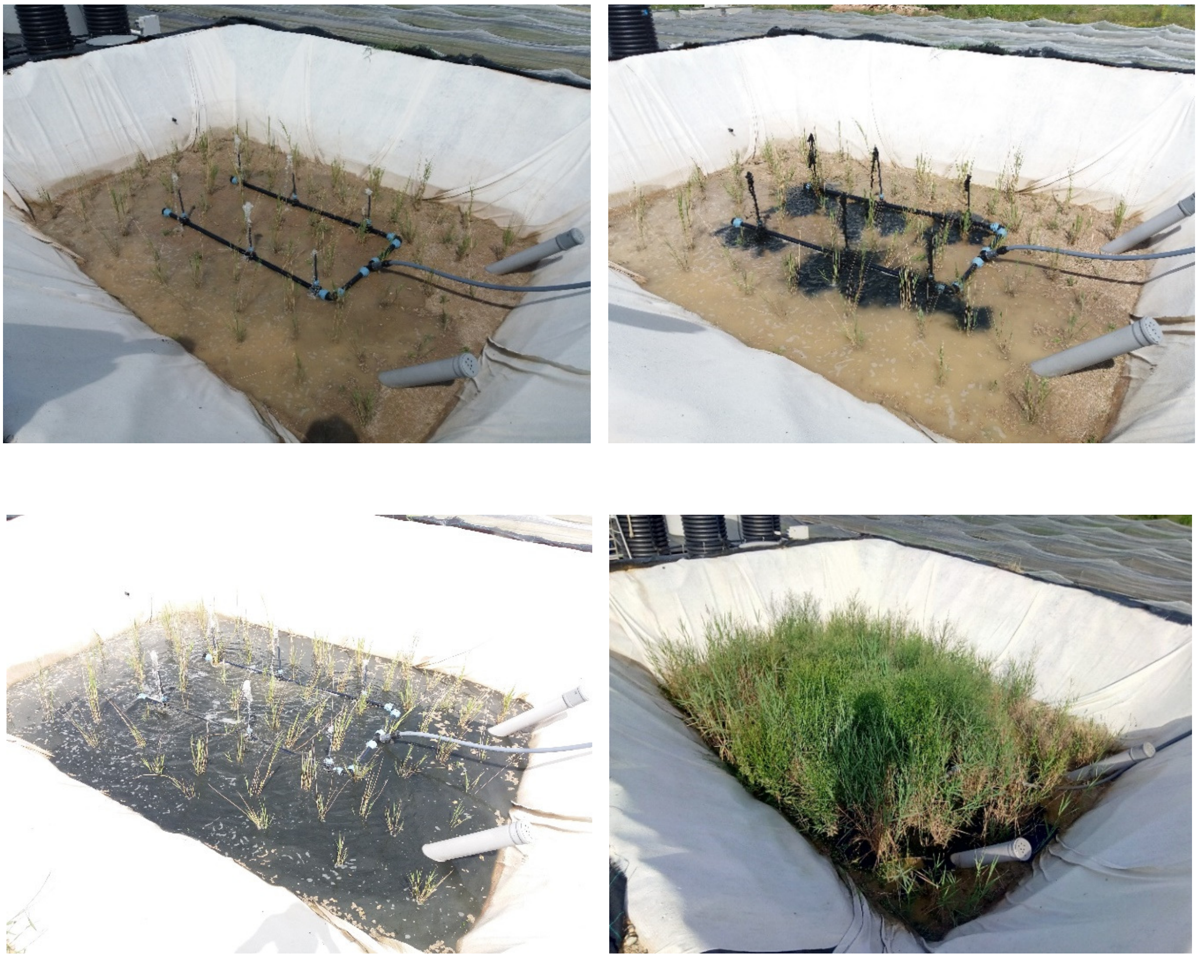

Figure 16. Sludge treatment wetland for digestate stabilization and dewatering: before feeding (up left), first feeding (up right), after feeding (down left), and after several months of operation (down right).

The effluent wastewater, after clarification in the settling tank, was filtered and disinfected in a solar-driven unit. A global view of the unit can be seeing in Figure 17, consisting of two feeding tanks, a compact box containing the filtration, disinfection and control devices, and a set of three photovoltaic solar panels for autonomous operation. A detail of the devices inside the box is shown in Figure 18.

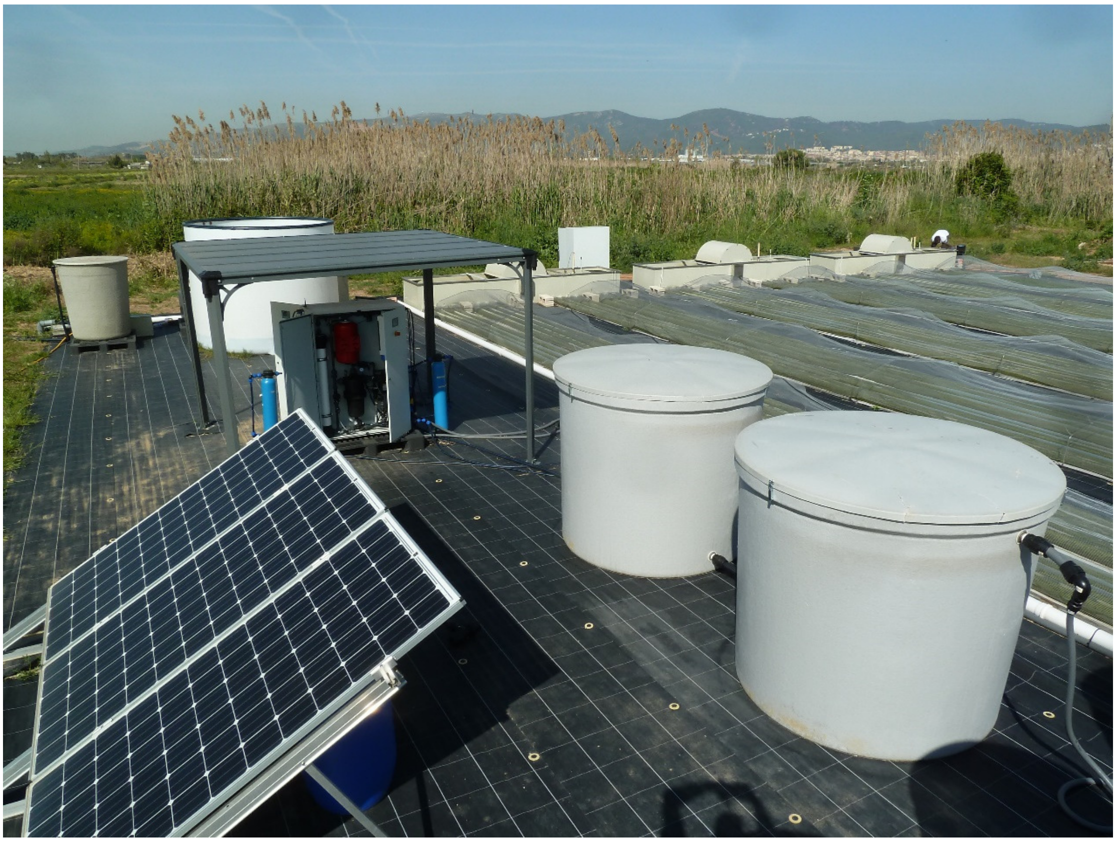

Figure 17. Solar-driven filtration and disinfection unit: feeding tanks (right), compact box containing the filtration, disinfection and control devices (under the roof), and photovoltaic solar panels (left).

Figure 18. Detail of elements and devices for filtration and disinfection contained inside the box.

The final postreatment consists in phosphorus recovery in adsorption columns filled with sol/gel coated calcite. The system is shown in Figure 19, consisting of three adsorption columns working in parallel. The same system is shown in Figure 20, after implementing an extra nutrients dosing system aimed at increasing the influent nutrients concentration. A detail of the adsorption material, disposed in bags, is shown in Figure 21.

Figure 19. Adsorption columns for phosphorus recovery.

Figure 20. Adsorption columns for phosphorus recovery, with a tank and system for dosing extra nutrients to the influent water.

Figure 21. Bags containing the adsorption material inside the columns.

The final effluent was applied in an agricultural field to grow energy crops by means of a smart irrigation system. The agricultural field is shown in Figure 22. A crop of rapeseed was grown in spring time (Figure 23), and a sunflowers crop was grown in summer time (Figure 24).

Figure 22. Agricultural field for smart irrigation of crops.

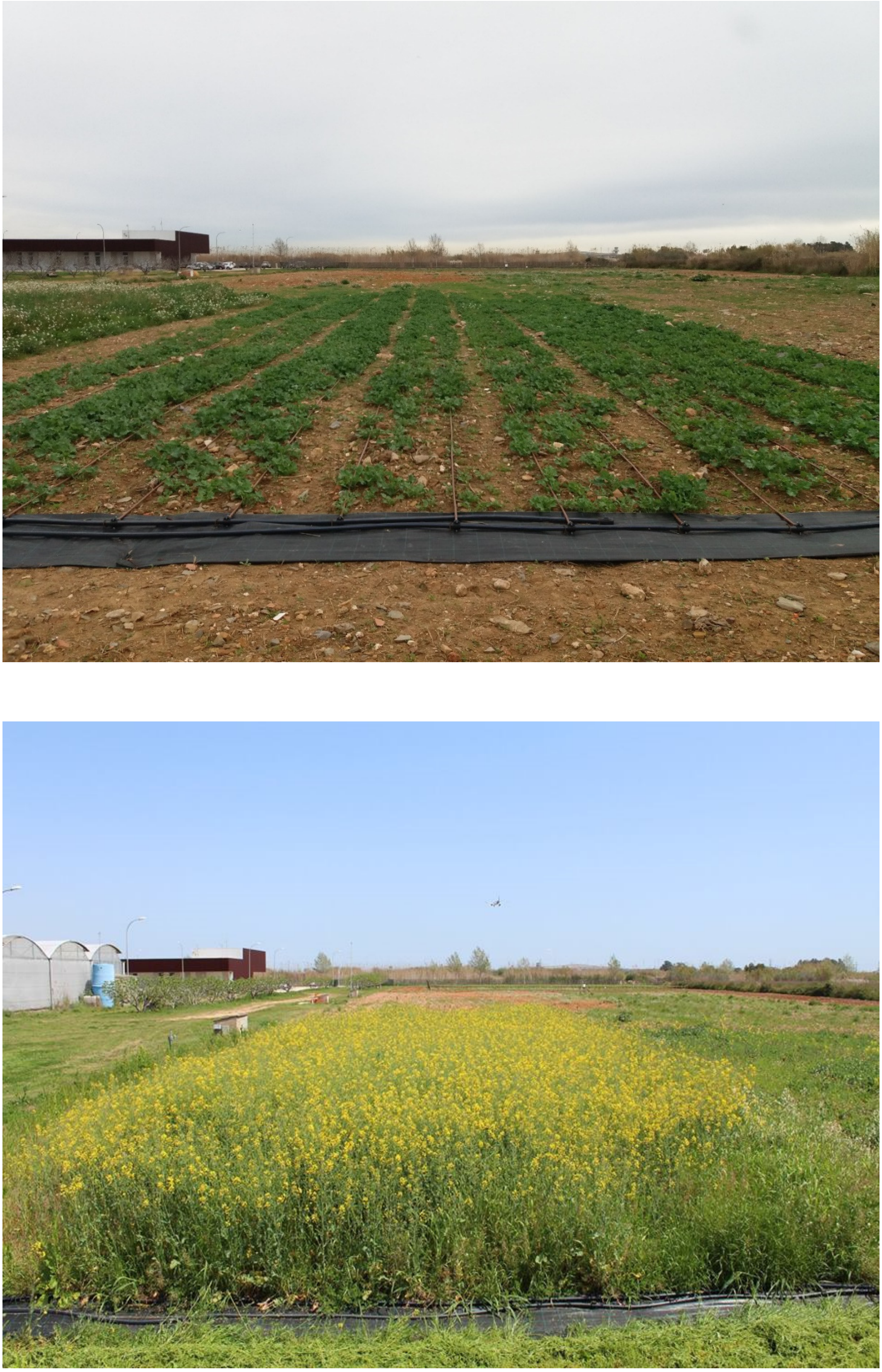

Figure 23. Two stages of the rapeseed crop.

Figure 24. Four stages of the sunflowers crop.