Improvement of soil conditions

The Polyfarming system, based on incorporating plant materials into the soil, **improves soil conditions** in the places where it is applied. After applying this model to the Planeses farm for three years, **the organic matter in the soil has practically doubled** in the different elements of the system. This is accompanied by **an increase in the amount of nitrogen, a higher C/N ratio and more water** in field capacity in these areas, compared to others in which a conventional system is applied.

Changes in the soil as a result of the regenerative model

The most important potential carbon stock in natural systems is the soil. One of the current problems is that the conventional model destroys the structure of the soil with the plough and favours the mineralisation of organic matter by continuously removing it, thus releasing the carbon that was retained in the soil into the atmosphere. In contrast, **the regenerative model seeks to preserve the structure of the soil and feed its trophic web**, reducing carbon from the atmosphere and introducing it into the soil. In this way, the soil becomes a large carbon reservoir again, a function that it has been losing for decades.

The regenerative model ensures that harvesting does not significantly affect the productive potential of the soil, while minimising external contributions and maintaining the main carbon stocks. To do this, **it improves soil conditions by incorporating plant materials into it**. This organic matter incorporated in the surface provides nutrients and plays an important role in covering the soil surface and increasing water reserves for plants.

Improved soil conditions

In the Polyfarming components, which have been developed on the Planeses farm since 2017, **significant improvements have already been obtained in various soil characteristics**. A study of these characteristics was carried out at the beginning of the application of Polyfarming (2017) and, three years later (2020), **in the following habitats**: (A) mature forest, (B) pasture where cows graze, (C) pasture where chickens and rabbits graze (only in 2020), (D) garden without tillage, and (E) garden of a neighbouring farm where conventional agriculture is carried out (**Figure 1**). Four of the main aspects related to soil fertility and productivity have been analysed.

• Organic matter

Organic matter mostly corresponds to humified organic materials. It presents greater stability than the plant matter from which it comes and represents a very important stock within the system. **It is the main indicator of the amount of carbon that a soil can store** and, indirectly, the amount of water available to plants, not only directly due to the ability of humic substances to retain water, but also indirectly due to the improvement of the structure in the form of a greater abundance of microaggregates. **Figure 2** shows the changes in the **% of soil organic matter between the start of the application of the Polyfarming system (2017) and three years later (2020)** in the four habitats considered (the chicken pasture is not included because it does not have data for 2017). As expected, the highest value of organic matter is obtained in the two samplings in the forest. In the two habitats in which Polyfarming was applied (cow pasture and non-tillage orchard) an **increase of almost double** the amount of organic matter was observed. In contrast, the conventional orchard maintained much lower values both in 2017 and 2020 (**Figure 2**).

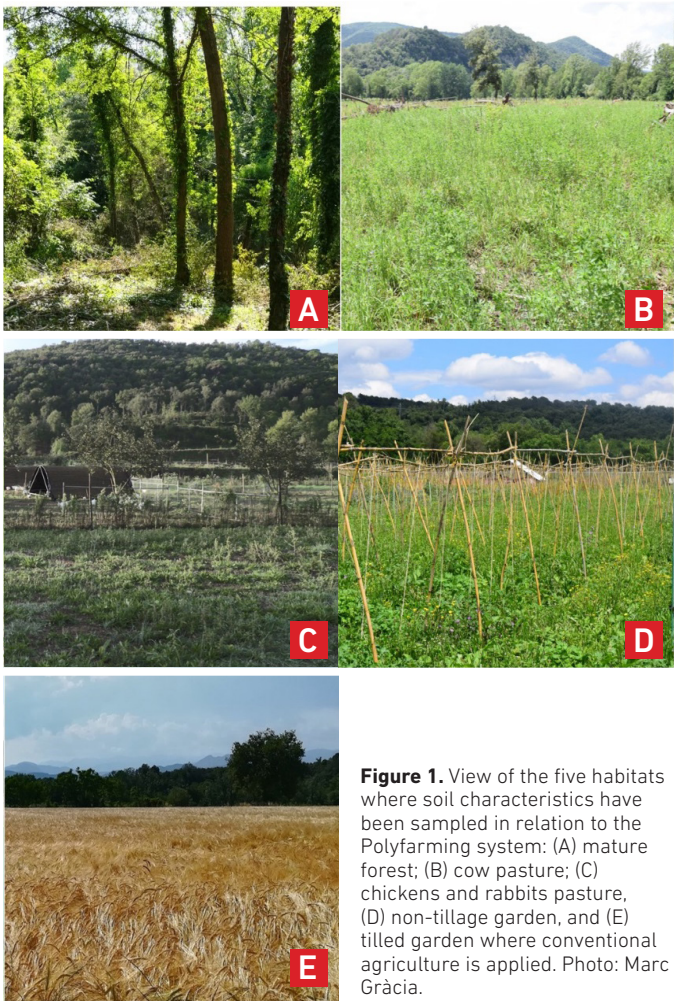

Figure 1. View of the five habitats where soil characteristics have been sampled in relation to the Polyfarming system: (A) mature forest; (B) cow pasture; (C) chickens and rabbits pasture, (D) non-tillage garden, and (E) tilled garden where conventional agriculture is applied. Photo: Marc Gràcia.

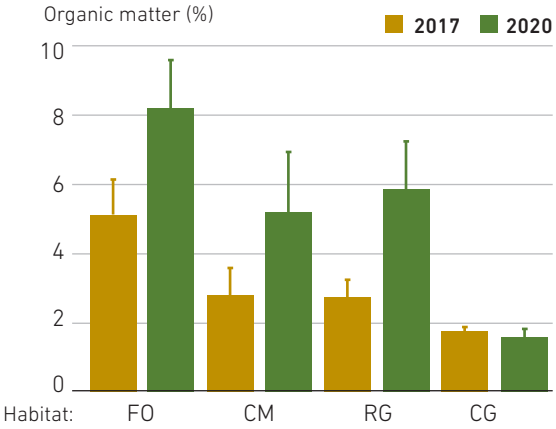

Figure 2. Changes in the % of soil organic matter (mean ± standard deviation) between the beginning of the application of the Polyfarming system (2017) and three years later (2020) in the four habitats considered: forest (FO), cow meadow (CM), regenerative garden (RG) and conventional garden (CG).

• Nitrogen

Nitrogen has been measured through the **Kjeldahl method**, it includes both organic nitrogen and that in the form of NH_4, i.e., nitrogen that is potentially available to plants. High nitrogen values are associated with increased levels of organic matter. **The highest nitrogen values are obtained in the forest and in the non-tillage orchard**, while both in the cow pasture and in that of chickens and rabbits the values are intermediate (**Figure 3A**). The lowest value is found in a conventional garden.

• C/N ratio

The C/N ratio of the soil varies fundamentally according to the C/N ratio of the existing plant organic matter. **A balanced soil in terms of the C / N ratio is around 10** (between 8 and 12), a value that indicates that there are contributions of fresh organic matter while there is a good content of humus-type organic matter.. In the habitats considered in the study, the two that have a value very close to 10 are the **forest and the cow pasture** (**Figure 3B**), confirming that they are fertile soils. In the other two Polyfarming habitats, the chicken and rabbit meadow and the non-tillage garden, the value obtained is slightly lower, around 8, still in the range of balanced soils. On the other hand, **in the conventional orchard the C/N ratio has a value of 6**, which indicates that there are few contributions of vegetable matter and a slow mineralisation rate.

• Amount of water in field capacity

The water content in field capacity corresponds to the water that remains in the soil 24 hours after saturating it, and indicates the useful water retention capacity for plants. The **highest values of water available for plants** are in the forest followed by the non-tillage orchard and the cow

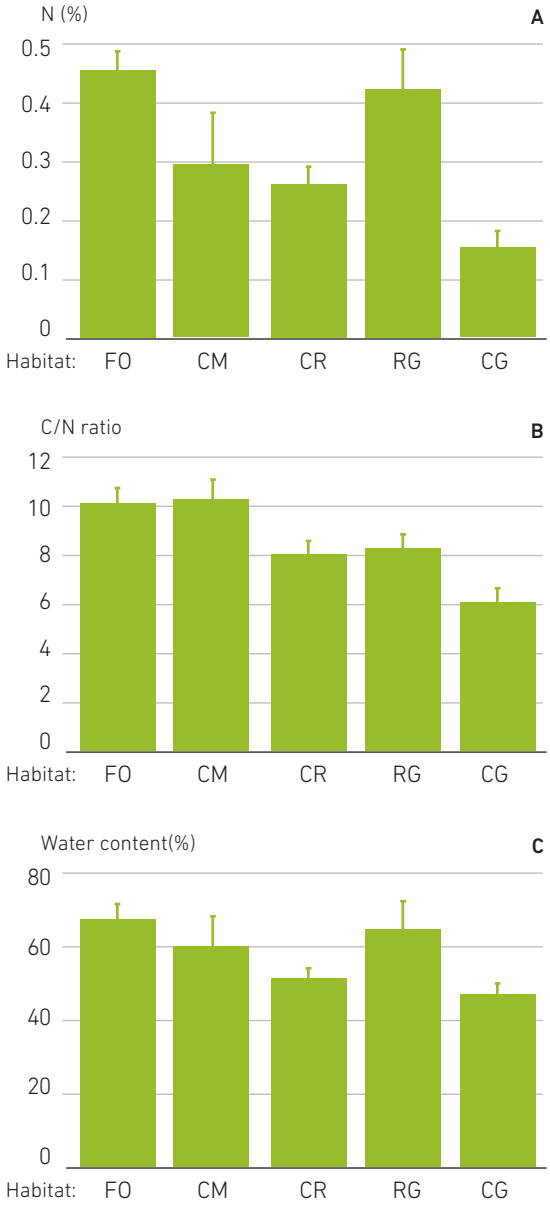

Figure 3. Values (mean ± standard deviation) of (A) total nitrogen (%), (B) C/N ratio, and (C) water in field capacity (%) in the five habitats considered: forest (FO) , cow meadow (CM), chicken and rabbit meadow (CR), regenerative garden (RG) and conventional garden (CG), after three years of operation of the Polyfarming system.

pasture (**Figure 3C**). The chicken and rabbit pasture has an intermediate value and the lowest value occurs in the conventional garden.

From these results, it can be concluded that **the Polyfarming system represents an important improvement of the soils in which it is applied**. Thus, soil organic matter, which is considered an indicator of soil health, **practically doubles in three years** in areas where the regenerative model is implemented. This is accompanied by an increase in the amount of nitrogen, a higher C/N ratio and a greater amount of water in field capacity in these areas compared to others in which a conventional system is applied.