Summary report on the execution of the field plot experiments

Milestone no. 8

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Experimental setup

The field plot experiment was carried out in three different countries that represent different vegetation and climate zones in Europe: Finland, Germany and Spain (Figure 1). The aim of the experiment was to give a comprehensive picture of the effects and fate of microplastics (MP) and plastic additives (PA) in real, varying environmental conditions across Europe.

At each location, 25 study plots with size of 3.5 m x 4.5 m were established in an area of 51 m x 51 m (Figure 2). Micronized pellets made of recycled mulching films were used as test materials (PAPILLONS material codes P3 and P4). One of the materials was made of conventional polyethylene (PE-MP; P3) and the other one was made of biodegradable PBAT-starch-blend (PBAT-BD-MP; P4). The test materials were applied to the study plots in two estimated concentrations, both of which represent environmentally relevant concentrations in agricultural soil: approximately 0.005% and 0.05% per dry weight (Table 1). Each treatment was implemented with five replicates (Figure 2). After introduced on soil surface (Figure 3), the MP test materials were mixed into soil with a rotavator and malted barley was sawn on the fields (Figure 4).

To study monthly atmospheric deposition of microplastics at the study sites, an open-face collectors were placed at each site (Figure 5).

A teabag approach was used to study the potential impact of MPs on the decomposition process in soil. Six dried and pre-weighed tea bags were buried in each plot, three containing green tea and containing rooibos tea (Figure 6). After 3 months (90 days), the bags are retrieved, dried and weighed.

Figure 1. The study sites for the field plot experiment in Spain, Germany and Finland.

Table 1. The mass of MP added to each plot in the field experiment to reach estimated concentrations of 0.005% and 0.05% (w/w) when the plastic was mixed in 10 cm layer of soil.

Concentration	Plot size (m^2)	Estimate for soil mass in 0.1m x $1m^2$ (kg)	Estimated soil mass to mix the MP (kg)	MP per plot (kg)
0.005 %	15.75	150	2362.5	0.118
0.05 %	15.75	150	2362.5	1.181

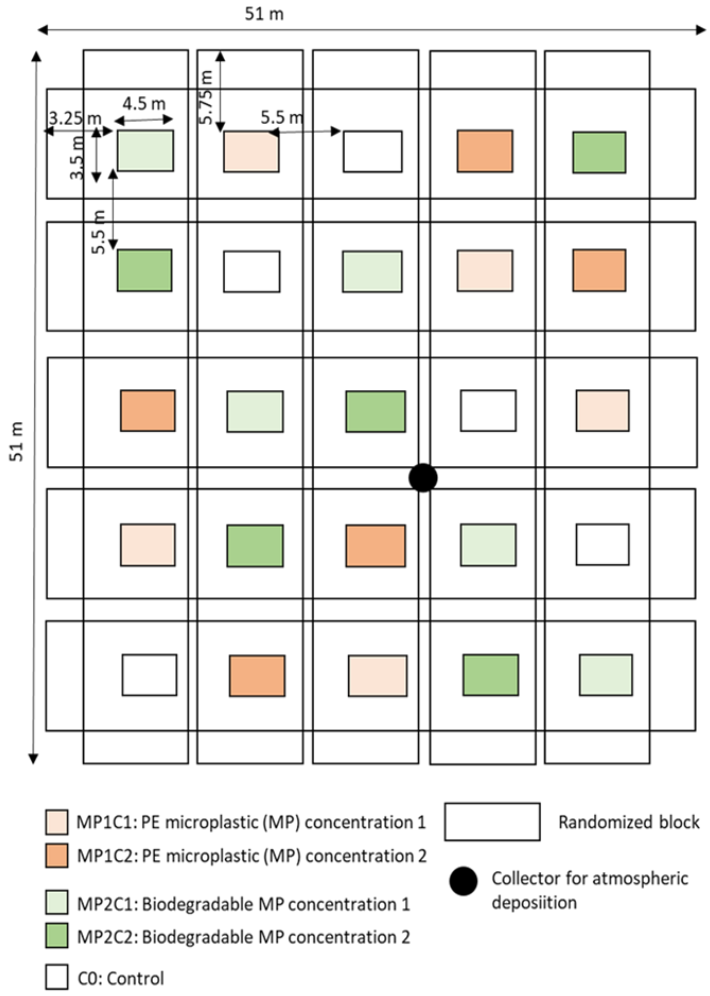

Figure 2. Experimental design of PAPILLONS field plot experiment.

Figure 3. Introducing the microplastic materials in soil. Photos: Paula Redondo-Hasselerharm

Figure 4. Mixing the test material in soil with rotavator and sawing the barley. Photos: Paula Redondo-Hasselrharm (left) and Johanna Nikama (right)

Figure 5. Measuring atmospheric deposition: Sample collection, sample and filtering. Photos: Paula Redondo-Hasselerharm

Figure 6. Measuring litter decomposition with teabag approach. Photos: Salla Selonen (left) and Paula Redondo-Hasselerharm (middle and right)

Sampling

During the growth season, barley samples were taken in different growing stages and surface leaf area and necrotic tissue were measured (Figure 7).

Before harvesting, the teabags were removed from the soil and weighed to measure the mass loss due to decomposition process in soil (Figure 8). After harvest (Figure 8), the quantity and quality of the crop was measured and samples of grains were frozen for plastic additive analyses.

Figure 7. Sampling of barley leaves on different growing stages: stage 32 (left), stage 39 (middle) and stage 58 (right). Photos: Sylwia Adamczyk (left and right) and Paula Redondo-Hasselerharm (middle).

Figure 8. Sampling the teabags (left) and harvesting the barley (right). Photos: Salla Selonen (left) and Johanna Nikama (right).

After harvest, soil samples were taken to measure soil physicochemical properties, microplastics, plastic additives, eDNA (microbial community, microfauna) and microbial activity (Figure 9).

For soil invertebrates, enchytraeid worms, microarthropods and earthworms were sampled to analyse abundance and the community composition. In addition, earthworms were sampled also for microplastics and plastic additives (Figure 10).

Figure 9. Taking soil samples Photos: Salla Selonen (left and middle) and Johanna Nikama (right).

Figure 10. Sampling earthworms. Photos: Salla Selonen.