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Large scale decomposition experiment in urban gardens with the tea bag method

Introduction

Decomposition is an essential process for nutrient cycling involving mineralisation and humification of organic material and leaching of soluble compounds [1] (Fig.1). Decomposition of plant material is mainly controlled by (i) physical factors, (ii) litter quality and (iii) decomposer organisms which fragment plant residues and facilitate an establishment of a community of decomposing microorganisms [5,7]. The factors which determine decomposition are relatively well known but only very few studies have analysed decomposition with plant litter on a global scale [4].

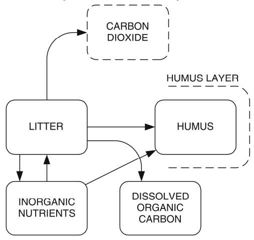

Fig. 1 Litter decomposition transformation from litter to humus and inorganic C. CO2 is formed by the biological activity of the microorganisms and detritivores. Newly formed DOC and soluble compounds can be leached out and stable humus forms remains (Berg & McClaugherty 2014).

Study sites

The tea bag method was applied on private and allotment gardens in the city of Zurich (Fig.2). The gardens were chosen according to the overall project design (www.bettergardens.ch). There are three main types of gradients within the gardens:

- **(i) Structural complexity** (plant diversity and available niches)
- **(ii) Urbanisation gradient** (starting from the central city to surrounding areas)
- **(iii) Gradient of disturbance** (always two distinct areas in one garden)

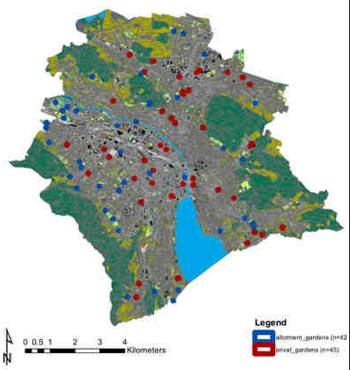

Fig. 2 Position of the urban gardens within the city of Zurich. In blue allotment gardens and in red private gardens.

Hypothesis

- We expect a faster decomposition of the green tea compared to rooibos tea bags (Fig.3).
- Soil with good soil quality (based on other parameters not shown here) fosters rates of decomposition.
- Disturbed areas have different decomposition rates than undisturbed areas.

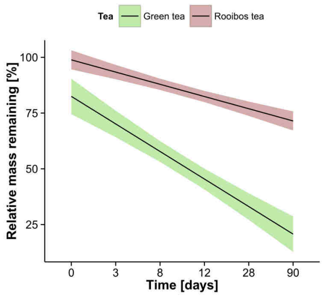

Fig. 3 Relative expected mass loss of the different tea bags, according to the laboratory incubation study by Keuskamp et al. (2013).

Materials and methods

The tea bag index (TBI) is a sensitive and robust method for testing decomposition rates in contrasting ecosystems and biomes [3]. The standardised method enables comparison of decomposition rates on different soil types, biomes and with other urban ecosystems distributed all over the world.

The TBI consists of small litter bags which are commercially available tetrahedron-shaped synthetic tea bags containing two different types of tea. These rooibos and green tea bags (Fig.4) are buried in the top soil layer (at a depth of 8 – 10 cm) and retrieved after 90 days of decomposition. The initial weight and the marking of each tea bag are important points from the research protocol. The full protocol can be found on the website www.decolab.org/tbi/protocol.html. The small mesh size of 0.25 mm excludes macrofauna and bigger mesofauna [6].

Fig. 4 Synthetic tea bags (Lipton green tea EAN: 87 22700 05552 5, Lipton rooibos tea EAN: 87 22700 18843 8).

Decomposition rate constants can be estimated from early stage decomposition [1]. This requires time series, when only one litter type is used. Two litter types with contrasting decomposition rates allow to estimate decomposable fraction from green tea and decomposition rate constants from rooibos tea at a single time point of extraction [3]. Both decomposable fractions can further be calculated under the assumption that the stabilization factor is equal for both tea types, which was tested by Keuskamp et al. (2013).

There were two sites, differing in their degree of disturbance, for every urban garden (Fig.2). We placed 4 replicates of tea bags for every study site. This revealed in 8 tea bags per site and in a total number of 1360 tea bags (85 gardens x 2 sites x 2 different tea types x 4 replicates). The depth of the soil holes was 8 cm. For a set of 2 rooibos and 2 green tea bags we used wooden sticks to mark the sites and inform the gardeners in order to prevent excavation by chance.

Fig. 5 Set of 4 tea bags with marked wooden stick during field work.

Fig. 5 Installed tea bags on different sites (left: intensive vegetable production site, top right: extensive grassland site, bottom right: mixed culture with perennial herbs.

Literature

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