

Decomposition study using tea bags

In brief

Comparing the decomposition of green tea as a fast-decomposing material with rooibos, a material, which is difficult to break down, allows for the calculation of the *tea bag index*. This provides information on the capability of the soil as a living organism to transform organic residues back into plant-available nutrients and contribute to the build-up of soil humus. This technique is easy to apply. Place the tea bag in the soil and take it out after three months to see how much is left. It is fascinating to discover the result of our hardworking little helpers in the soil, and how this work provides nutrients to a new generation of plants for examining nitrogen-fixing root nodules.



Teatime for soil organisms

After photosynthesis, decomposition is the second most important ecological process, taking place in the soil. While photosynthesis by plants is producing biomass from CO₂, minerals, and solar energy, soil organisms are the eye of the needle, because it is through them that materials enter the soil. They use the energy from the litter material for maintenance and biomass build-up.

Tea bags, which are made of non-biodegradable nylon mesh, provide a very convenient tool for studying decomposition in soil. The tea is consumed by soil organisms and the resulting weight loss represents a measure of decomposition, which is driven over time by the catabolic activities of soil organisms. The tea bags contain a relatively uniform organic material and are produced under standardised conditions. Two different types of tea (rooibos and green tea) are used.

This provides information about the stabilisation of decomposition rates with the fast-decomposing green tea, and about the dynamic decomposition rates with the use of the more recalcitrant rooibos tea.

With the use of two contrasting tea types, rates and stabilisation factors of decomposition can be compared between fields and soils. The approach is part of a global study on geo-climatic effects on decomposition.



Tea bags (rooibos and green tea) with the nylon mesh.
Photo: Simon Tresch, FiBL

Investigation method

Try to follow how your tea bags are broken down into their basic elements in your own field, garden or compost heap. While taking a break from sewing litterbags and placing them carefully on the field, Keuskamp et al. (2013) had the idea to use tea bags. They realised that these non-biodegradable nylon tea bags are standardised little litterbags. So they found a simple and cheap method without much effort or instrumentation.

Due to its ease of performance, the decomposition of the two types of tea has resulted in a global study (<http://www.teatime4science.org/>). Nonetheless, there are potential problems that have to be taken into account: The tea contains flavouring flowers and there may be aromas. So it is not only one plant material. The teabags will contain some soil material after incubation in the soil. For correct results and precise scientific studies, the tea will be incinerated at the end, which is a major part of the work.

Materials needed

- Green tea: Please use the tea bags available at <http://www.dutchsupermarket.com/en/lipton-green-tea-sencha.html>*
- Rooibos tea: Please use the tea bags available at <http://www.dutchsupermarket.com/en/lipton-rooibos-tea.html>*
- Permanent marker
- Shovel
- Stick or twig
- Drying stove (max 60°C)
- Muffle furnace (600°C)
- Scale with a 0.000 precision

*At the Dutch Supermarket online store, you will get a 10% discount when you enter "tbi" in the appropriate field on the billing site.



Lipton Tea bags. Photo: Kathrin Huber, FiBL

How to proceed

- Take a couple of tea bags of each kind (green and rooibos tea) and weigh them, including the label and the

string. In order to know the weight of the nylon bag, the string, and the label, open at least ten tea bags of each kind and weigh them separately. The bags contain 1.6 to 1.8 grams of tea.

- Use five replicates of green tea and rooibos tea bags as a minimum number to obtain better estimates, and mark their labels with a permanent marker.
- Bury them pairwise (rooibos and green tea) and close to each other at 8 to 10 cm depth in neighbouring holes. You may consider more levels (compare with Figure 1).
- You may use a 30 mm soil corer. Do not compact the soil, and keep the disturbance as low as possible. Refill the holes with soil from the soil core.
- Keep the labels visible on the soil surface.
- Mark the site with an easily visible stick.
- Record the date, the geographical position (GPS or field map) and important site information (soil type, crop, fertiliser use, soil tillage, etc.)
- Dig out the tea bags after 90 days. In warmer climates, this time may be shorter. Record the date and any additional information.
- Remove adherent soil and dry the teabags carefully in the sun or at 60°C (maximum) in a stove.
- Weigh the tea bags after drying.

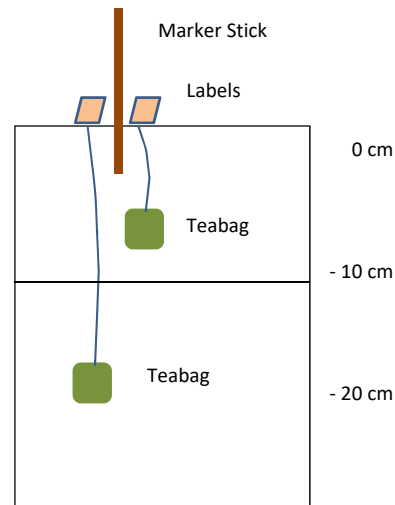


Figure 1: Analysis of the decomposition in two soil layers

In order to take into account the error due to soil in the teabag, you have to open each bag, take out the content and fill place into ceramic crucibles. Place them in the furnace and heat for four hours at 600°C. Weigh the crucibles with tea before and after incineration. Make sure that the tea is completely dry. Incinerate a couple of original teabags, too. An Excel sheet for calculation is provided on www.fertilcrop.net.



Sticks showing where the tea bags are buried in a garden. Photos: Simon Tresch, FiBL

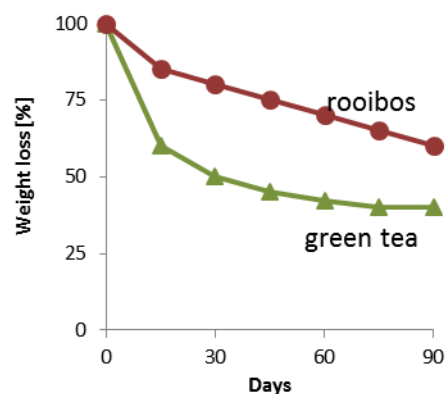


Figure 2: Schematic decomposition



Tea bags, original and dug out. Photos: Kathrin Huber, FiBL

More than the basic approach

The most basic approach is to leave the tea bags in the soil for 90 days and then weigh them. However there is more you can do with it. For your own interpretation, you need a comparison or reference. For example, you compare a site that shows reduced plant growth with a site where plants grow normally. You can compare your lawn with a vegetable bed, a recently ploughed field with a no-till field, and so on. Please make the results available in tea4science.

Different soil depths, seasonal effects, detailed resolution

- You can check different soil depths in terms of their decomposition potential (Figure 1).
- You can check for seasonal effects by placing teabags in different seasons.
- You can check for a more detailed resolution of the decomposition process (Figure 2) by taking them out after defined incubation intervals.

Interpretation of the findings

You will see that the tea leaves will have become darker after 90 days and will have lost their original structure. You will hardly see the nice pieces of tea leaves you buried. Loss of weight and structure of the tea bags will depend on different soil conditions: dry, wet, cold, warm, compacted or well-structured.

Structure

- The two types of tea decompose at different speeds.
- Green tea will decompose fast in the first two weeks.
- Rooibos tea has a more woody texture, which is more difficult to decompose for soil organisms. After three months, rooibos will still show its original shape, and the process of decomposition will still be ongoing.

Weight

- After three months in the soil, the tea may have lost about 50% of its original mass, depending on the activity of your soil and the organisms in it.
- The more material is lost, the more active soil organisms are breaking down the organic material.

What conclusions can be drawn?

Are you experiencing problems with plant growth in certain areas? Maybe one of the reasons is bad soil quality, as indicated by delayed tea bag decomposition. Compare the decomposition of the two types of tea in the problem area with the one where plants are growing normally.

References

Keuskamp, J.A., Dingemans, B.J.J., Lehtinen, T., Sarneel, J.M., Hefting, M.M. (2013): Tea Bag Index: a novel approach to collect uniform decomposition data across ecosystems. *Methods in Ecology and Evolution* 4, 1070-1075.

The calculation of the *tea bag index* can serve as a tool to evaluate management or treatment effects, such as pesticide and fertiliser effects, drought and flooding effects.

Scientific studies use teabags as indicators of healthy soil and may develop sophisticated test systems and other soil analyses that go with it (e.g. the analysis of microbiota in the teabags, the analysis of the remainder for its biochemical composition).

More information

For more information about the tea bag index, and how to provide your data, visit <http://www.teatime4science.org/> and be part of the global study.

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Picture cover page & graphs

Picture cover page: The tea bags are buried and their labels are fastened on a stick, by Simon Tresch, FiBL.

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This technical note is available at www.fertilcrop.net.

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About FertilCrop

Fertility Building Management Measures in Organic Cropping Systems – FertilCrop is a project funded by the CORE Organic Plus funding bodies, being partners of the FP7 ERA-Net project CORE Organic Plus. The overall aim of FertilCrop is to develop efficient and sustainable management techniques aimed at increasing crop productivity in organic farming systems. More information about FertilCrop is available at www.fertilcrop.net.

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