Department of Geography and Environmental Science

University of Reading

1ST TEA BAG INDEX (TBI) WORKSHOP

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#TBIMeet16

1. INTRODUCTION

The Tea Bag Index (TBI) is a standardised method to measure organic matter decomposition rates in soil. It can be used as reference material in scientific decomposition experiments and for citizen science.

More details of which can be found by following the links below:

www.decolab.org/tbi/

www.teabagindexuk.wordpress.com

The method consists of burying tea bags, and does not require a large effort or complicated instruments. This method was developed and tested by a team of researchers and has applications in soil research of decomposition rates in the field, as well as part of larger crowdsourcing projects.

2. FORMAT OF THE DAY

The one-day workshop, hosted at the University of Reading, was split into three parts. Part one consisted of a series of talks on the TBI including:

➢ An introduction to the method
➢ Potential applications
➢ Chemical underpinning
➢ Considerations of limitations
➢ Citizen science and crowdsourcing
➢ Consideration of audiences

All presentations have been made available in the workshop dropbox folder, which can be found by following the link below::

https://www.dropbox.com/sh/q3gpq98fl69qj59/AABT2FUoktpC3pALf0xkOCD5a?dl=0

Part two saw the launch of the new call for participants for the TBI to increase global cover, details of which can be found later in this document.

The third, and final part of the day consisted of a series of break out groups focussing on:

- Experimental design, validation and testing
- Considerations/ limitations encountered
- Citizen science
- Funding and building networks

A summary of these discussions has been included below.

3. APPLICATIONS

The TBI has applications in testing both environmental gradients, as well as experimental treatments in a number of settings. The predictions on a two phased model obtained by TBI improve insight compared to studies that only measure weight loss.

4. TBI METHODOLOGY AND VALIDITY

Theoretical considerations

The calculation of K and S from green tea and rooibos tea is based on several basic assumptions. Such as,

1. The labile fraction limit of green tea (a_g) is reached during the incubation time of 3 months
2. The labile fraction limit of rooibos tea (a_r) is not reached in this incubation time
3. The acid un-hydrolysable fraction (UHR) is resistant to decay
4. The S value is equal between rooibos and green tea
5. Formation of refractory secondary material is occurring instantly at the start of the incubation

Upon investigation of the material after incubation and the weight losses it is seems that in some cases the assumptions 3 and 5 are not met. UHR is not completely resistant to decay and decomposition of rooibos in some cases reach a_r within the incubation period. This in itself does not disqualify the method as k and S are still valuable indexes. In comparison, the traditional assumption made in decomposition experiments (homogeneous material, with a constant decay rate over time) is never met and the two phase approach of TBI is improving that.

Sensitivity analysis of the TBI parameters showed that the k value is fairly robust and violations of assumptions 1,2 can be easily checked, while only large deviations from 4 is problematic. As a safety rule for assumption 2 we propose that the weight loss of rooibos should not exceed 50%. If decomposition rates are extremely high, a shorter incubation time could be considered, as the risk that a_g will not be reached under such circumstances is low.

5. PRACTICAL CONSIDERATIONS

How to analyse data from replicates?

In most cases the scale of variability is smaller than the bag size which allows using a plot-average S to calculate k. This does require some critical consideration, however, as plot scale variability or gradients might ask for comparing tea in pairs of rooibos and green tea.

Adapted protocols and sources of variation.

Researchers may deviate from the protocol which will potentially results in variation between labs. Some modifications do not result in significant deviation (e.g. freeze drying instead of oven drying), so that data obtained this way still qualifies as TBI data. Other deviations result in a strong bias and therefore cannot be regarded as valid TBI data. Examples thereof are: incubation in the litter layer or on top of the soil

- ➢ Usage of pre-leached bags
- ➢ Excessively long incubation times
- ➢ The use of only one tea bag type used (green or rooibos).

Tea availability and standardisation

Lipton is the only provider of the tea and communication with Lipton or Unilever has not been easy. Alternative tea brands show high variation in quality and therefore cannot be used without critical consideration.

Weighing problems

Weighing with the use of TBI flyer is not as precise as we'd want it to be and therefore weighing with a more precise scale is preferred, if available.

Contamination of bags

1) What if a lot of fine sediment entered the bags making it difficult to assess weight loss?
A good solution is to use combustion and subtract mineral material, as this is all exogenous.

2) Do we need to correct for the SOM in the material?
Generally this can be ignored, as the infringing SOM is mostly negligible compared to the OM of the tea.

6. POTENTIAL LIMITATIONS

Interpreting TBI k and S values in the context of 'natural' decomposition dynamics:

- ➢ Stabilization in teabags is only chemical, due to physical separation with the soil, physical stabilization not possible. How big is this error?
- ➢ The mesh of the teabags excludes part, but not all, of the micro-fauna, resulting in modifications of both k and S.

- ➢ Root ingrowth is a major issue in some cases – although roots can be removed, there might still be a residual priming effect. A similar priming effect may occur through mass transport of fungal hyphae

Other issues:

- ➢ Ranges of values are unclear and relations between k and S were discussed.

We will be more clear on the interpretation of k and S on our website, we will give ranges and explain that a negative S value can occur. Also both positive and negative correlations are possible between k and S..

- ➢ Collecting uniform (environmental data) is problematic. E.g. soil moisture status

No clear solution proposed. Also quality of submitted data from citizens depends largely on trust.

- ➢ What is the wetting time of the tea bags? If this is slow, the timing of precipitation effects may exert a large influence the values of especially k

- ➢ Up to now there hasn't been a validation of TBI values against SOM or litter dynamics – this is indeed something that will be done when enough data are available

- ➢ The TBI is designed to be as simple as possible – this indeed sometimes results in variance which could have been excluded in a more complex method.

Use of TBI in more controlled experiments as to improve understanding of its interpretation:

- ➢ Usage of TBI in artificial communities, or natural communities which are modified by soil treatment (e.g. on golf courses), would elucidate the role of certain microbial groups in decomposition. This would be especially fruitful if combined with sequential extractions and/or NMR data
- ➢ A ring test in an ISO standardised soil would help in assessing the analytical variability – this could be readily done.
- ➢ 'Replicate sites' e.g. sites that are predicted to have similar k and S values could be used to test the variability of tea bags in the field.
- ➢ It would be great to not only look at chemical, but also at microbial succession during incubation.

7. CITIZEN SCIENCE

Citizen science can be a powerful tool, not only for science, but also for increasing impact in society. It also educates people and increases interest in future science careers.
It is relatively new, so best approaches need to be developed. Also within TBI this brings issues: Which tasks can be done by participants and by the scientists (weighing?). How to deal with variation and validation? Where to find participants?
Participants should receive feedback in form of results and appreciation.

Potential networks that could be interested in TBI are: Geocatching, meteorological amateur network, soil companies, British trust for conservation volunteers, Open universities.

8. FUNDING AND BUILDING NETWORKS

Funding is needed to keep up the momentum of TBI, and the TBI team will explore opportunities for a new COST-action, a H2020 call (in 2017), and Marie Curie Networks. Ideas for possible funding and networks that are interested to join the TBI call are more than welcome!

9. NEXT TBI WORKSHOP

Will be organised at AGES in Vienna in late February 2017.