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The Tea Bag Index - UK

Welcome to the Tea Bag Index – UK!

Thank you for agreeing to participate in the Tea Bag Index (TBI) UK project!

In this pack you will find everything you need to conduct your garden experiment.

As a willing participant you will not only be contributing towards my PhD, but also to a wider European project on soil decomposition rates, enhancing scientific understanding of soil processes.

Maintaining a healthy and vibrant garden is the aspiration of most gardeners and healthy fertile soil is a key component of this. Decomposition of organic matter is an important process in releasing nutrients into the soil for plants to use. Therefore, gaining a better understanding of this process will be of great value to gardeners in the UK.

In return you will receive regular updates on other Tea Bag Index experiments that are ongoing, both in the field and the laboratory across the country. Along with information on what we expect to be happening in your garden experiment at home.

Thank you for your help!

More details on the project can be found on the TBI UK website:

www.teabagindexuk.wordpress.com

Or you can follow the project on Facebook:

www.facebook.com/teabagindexuk

Or if you have any further questions you can email us:

teabagindexuk@gmail.com

The Method

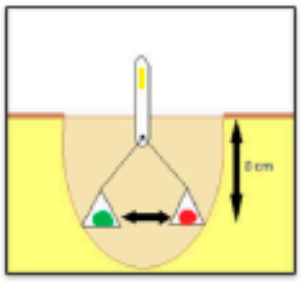
In your pack you should have:

1. Three pairs of tea bags tied to a marker, labelled A (Blue), B (Red) and C (Yellow)
    - You do not need to worry about the number alongside, this is for my reference when they are returned to the lab
2. Three small re-sealable plastic bags, labelled as above
3. A short questionnaire

How to bury them

N.B please do not use the tea bags before you bury them as this will affect the results

1. Select the location in your garden using the "where to bury them" guidance below
2. Dig a hole approximately 8cm (3 inches) deep, keeping the soil to one side
3. Place the two tea bags in the hole so that they are spread 5-10cm apart from each other (being careful not to put too much tension in the string)
4. Re-fill the hole with the soil you set aside in step 2. Keeping the top of the marker sticking out of the soil surface, this will help you to find them later (see diagram below)



5. Please ensure that the soil is packed in well so the soil is in contact with the tea bags, and there is soil in between the two tea bags.
6. Make a note of the date you buried them on the questionnaire in this pack, and if possible send me a photo of where you buried them.
7. Leave them underground for three months, or as close to three months as you can.

If you'd like to help me further publicise the project please send some photos of you burying your tea bags in your garden to teabagindexuk@gmail.com and I'll us them in my online media. Or you can tweet @TeaBagIndex using #TeaBagIndexUK. Please only send photos that you are happy for me to share.

Where to bury them

If possible, I would ask that you bury the tea bag pairs as follows, however if this not possible do please feel free to bury them where you wish, any help will be appreciated.

Pair A (Blue)

Under grass, such as your lawn.

The vegetation cover of lawns is relatively similar in most gardens Therefore, burying tea bags under lawns will allow me to look at whether the region you live in is having an effect on decomposition rate, as a result of local climate or soil type.

Pair B (Red)

In a place that you treat with organic matter (such as compost, horse manure).

This could be a flower bed, borders, a vegetable patch etc.

If you do not treat any part of your garden with compost, but use another form of fertiliser or soil amendment, then please bury this pair here. If you neither apply compost nor fertiliser, any area in your garden where there are plants can be used.

Pair C (Yellow)

Is up to you!

Please place Pair C in any area of your garden you are particularly interested in investigating, for example, a bare patch or an area that is often waterlogged. If you are unsure check our webpages online for ideas from other paticipants.

After three months

1. Dig up the tea bags. N.B the string can become weak over time so to avoid the string snapping and losing the tea bag do not attempt to pull them out of the ground by the string.
2. **PLEASE DO NOT RUN THEM UNDER WATER TO CLEAN THEM AS THIS WILL AFFECT THE RESULTS**
3. Take a sample of the soil surrounding the tea bags (about 5 teaspoons)
4. Leave the tea bags attached to the marker stick and place them somewhere to dry (in a window, airing cupboard etc.), along with the soil sample.
5. Put the soil sample in the plastic bag provided labelled with the same corresponding letter as the marker. For ease the markers and bags are also colour coded. (A – blue, B – red, C- yellow)

If one of the bags from a pair is missing, or either of the bags are ripped/ have large holes in, I'm afraid I will not be able to calculate a tea bag index for this pair. If this is the case, there is no need to send this particular pair back to me.

Checklist to return to me

1. Completed questionnaire
2. Three pairs of retrieved, dried tea bags, still attached to markers labelled A, B and C
3. Three dried soil samples, in bags labelled A, B and C
4. By email, any photos you would like to share with us to teabagindexuk@gmail.com

Sarah Duddigan
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Russell Building,
Whiteknights,
Reading
RG6 6DW

By submitting these materials you are giving me permission to use the data and publish any findings in both printed and online media. However, all published data will keep you anonymous.

Thank you for all of your help and I will be in contact when I have your data!

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Feel free to continue onto a separate sheet if you wish

Pack Number:

Tea Bag Index Participant Questionnaire

1. Post Code (where they were buried): _____
2. Date Tea Bags buried: _____
3. Date Tea Bags retrieved: _____

Pair A (Blue)

1. Where in your garden did you bury this pair? (the lawn, flower bed, border, vegetable patch, bare soil etc.)

_____

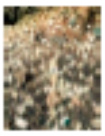
2. Do you apply any compost, manure or similar to this area of you garden? If so what? (e.g. composted garden/ food waste, horse manure etc.)

_____

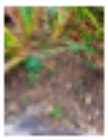
3. Do you apply any chemical fertilisers, pesticides or herbicides etc. to this area of your garden? If so what?

_____

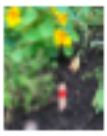
4. If we drew a rough 50cm (1½ft) square, with the tea bags in the centre, what would the plant cover be? (please tick)



Bare Soil ☐



Less than 50% plant cover ☐



Half plants, half bare soil ☐

More than 50% plant cover ☐

Total Plant Cover ☐

Please use this space for any other information you would like to provide:

_____

_____

_____

Pair B (Red)

1. Where in your garden did you bury this pair? (the lawn, flower bed, border, vegetable patch, bare soil etc.)

_____

2. Do you apply any compost, manure or similar to this area of you garden? If so what? (e.g. composted garden/ food waste, horse manure etc.)

_____

3. Do you apply any chemical fertilisers, pesticides or herbicides etc. to this area of your garden? If so what?

_____

4. If we drew a rough 50cm (1½ft) square, with the tea bags in the centre, what would the plant cover be? (please tick)

Bare Soil	Less than 50% plant cover	Half plants, half bare soil	More than 50% plant cover	Total Plant Cover
☐	☐	☐	☐	☐

Please use this space for any other information you would like to provide:

_____

_____

_____

Pair C (Yellow)

1. Where in your garden did you bury this pair? (the lawn, flower bed, border, vegetable patch, bare soil etc.)

_____

2. Do you apply any compost, manure or similar to this area of you garden? If so what? (e.g. composted garden/ food waste, horse manure etc.)

_____

3. Do you apply any chemical fertilisers, pesticides or herbicides etc. to this area of your garden?

_____

4. If we drew a rough 50cm (1½ft) square, with the tea bags in the centre, what would the plant cover be? (please tick)

Bare Soil	Less than 50% plant cover	Half plants, half bare soil	More than 50% plant cover	Total Plant Cover
☐	☐	☐	☐	☐

Please use this space for any other information you would like to provide:

_____

_____

_____

You will receive information on the findings of the study using the email address you provided at the beginning of the study.

Figure S1. – Joining information booklet sent to participants.

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The Tea Bag Index - UK

Thank you from the Tea Bag Index – UK!

This project is an important part of my PhD research, and I would like to thank you all again for being a part of it. Without your overwhelming support this work would not have been possible.

With your help I have been able to collect around 700 samples from across the length and breadth of the UK. You have sent me samples from your lawns, flower beds, vegetable patches, rockeries and less managed bare sites. All have which have been a great help in this project

However, do please keep in mind that this research is still ongoing, so I am not going to pretend I have all of the answers.

When improving and working with your garden, having an understanding of your garden soil is the best place to start. It is always an ongoing job, and a situation that is not always easily fixed. But hopefully taking part in this experiment has set you on to the correct path of loving your soil!

Do please keep an eye on the project on the project can be found on the TBI UK website:

www.teabagindexuk.wordpress.com

Or you can follow the project on Facebook:

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Or Twitter:

@TeaBagIndexUK

#TeaBagIndexUK

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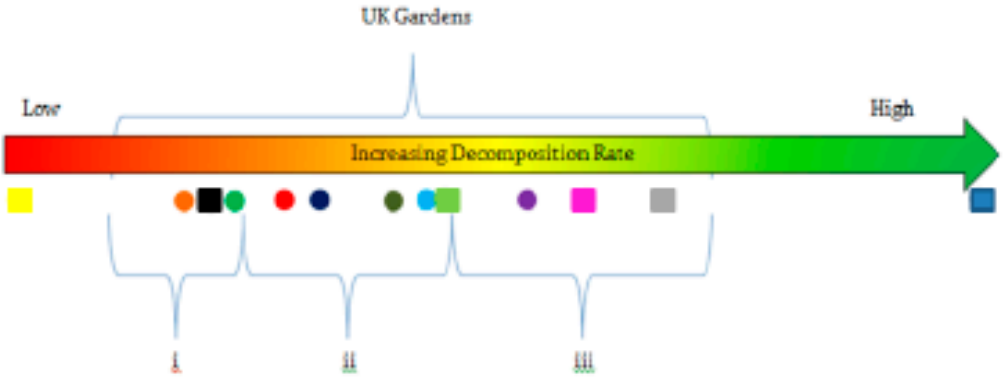
Your Results

The important thing to remember is that, of the samples returned to me, not one had a decomposition rate or C:N ratio that was cause for concern. The UK garden samples, sent in by all of you, sit exactly where I would expect them to.

Tea Bag Index Decomposition Rate

To give you an idea about how your garden compares to others I have classed your decomposition rate as being in one of three groups (i, ii or iii). The diagram below shows other soils that have decomposition rates that are also within these three groups for you to compare you results, from both natural ecosystems and my controlled field experiment at RHS Wisley.

To give you an idea of how temperature can have an effect on decomposition I have included results from my field experiment, taken in both the summer and winter.



- Desert
- Grassland
- Mangrove
- Temperate Forest
- Tropical Forest
- Pasture
- Wisley Soil, Composted Bark, Winter
- Wisley Soil, Composted Bracken, Winter
- Wisley Soil, Composted Peat, Summer
- Wisley Soil, Nothing Applied, Summer
- Wisley Soil, Composted Bracken, Summer
- Wisley Soil, Garden Compost, Summer
- Wisley Soil, Spent Mushroom Compost, Summer

An important thing to remember is that, no one group is 'better' than another, each has their benefits. A soil with high decomposition means there is a more active microbial population decomposing organic matter, and releasing nutrients, than a soil with less decomposition. However, a high decomposition rate soil also releases the greenhouse gas carbon dioxide (CO_2) into the atmosphere, because this is created by microorganisms while they break down organic matter in soil.

There are a number of different possible reasons for differences in decomposition rate in soils, many of them I am still trying to understand through this research (which is why I have decided to run the project for another year). These include temperature, soil type, organic matter content and soil moisture content to name but a few. If you are interested in reading more, you can do so on the project website, particularly the page below:

www.teabagindexuk.wordpress.com/07-what-affects-decomposition/

An important soil characteristic that affects decomposition is the C:N ratio of the soil (see below).

C:N Ratio

The Carbon:Nitrogen (C:N) ratio is expressed as how many units/ parts carbon are present in a material compared to one unit of nitrogen. For example a C:N ratio of 20 (also expressed as 20:1) means that there is 20 times more carbon than nitrogen in that sample.

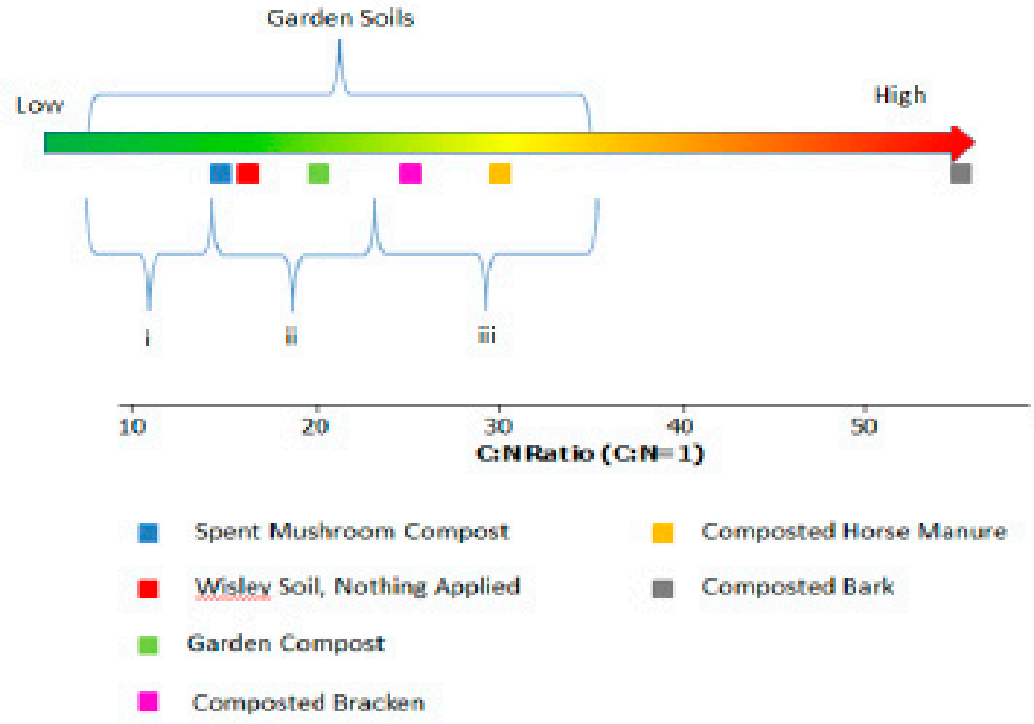
Again, none of the results from the samples you posted to me are high or low enough to raise concerns, but I have also given a C:N ratio category (i, ii or iii) to all of you. The graphic below should be able to help you see how this compares to other garden soils.

Soil microorganisms use nitrogen in the soil to break down the carbon. Unfortunately, nitrogen is also one of the most important nutrients for plant growth. Therefore soils that have less Nitrogen present (i.e. a high C:N ratio) can often result in plants showing symptoms of nitrogen deficiency, such as stunted growth and yellowing leaves.

An excess of nitrogen, on the other hand (i.e. a low C:N ratio) can fuel rapid growth of soft, sappy leaf foliage. This may sound like a good thing, but the growth of too many leaves is often at the expense of other parts of the plant such as flowers, fruits, roots and even reproductive parts of the plant. Excess nitrogen can also be leached from the soil in wet weather and contaminate groundwater and rivers.

If plants show any of the symptoms in either of these scenarios a possible way to correct this would be to apply material of the opposite C:N ratio (apply high C:N material to a low C:N soil etc.)

Examples of materials with high C:N ratios include more 'woody' materials such as woodchips, tree prunings, paper, composted bark, sawdust, straw etc. Example of materials with low C:N ratios include vegetable scraps, grass cuttings, coffee grounds, fresh weeds etc.



Thank you again from the Tea Bag Index – UK!

Figure S2. – Results information.

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Table S1. - Mean tea bag index and soil carbon from returned samples.

		Tea Bag Index		Soil Samples		
		Decomposition rate, k	Stabilisation factor, S	Total C (%)	Total N (%)	C: N
No amendments applied (including lawns)	Atlantic Central (n =194)	0.016±0.001	0.178±0.006	6.93±0.25	0.41±0.01	16.96±0.37
	Atlantic North (n=56)	0.016±0.001	0.203±0.010	8.28±0.85	0.92±0.52	19.72±0.97
	Mean (n = 250)	0.016±0.001	0.184±0.005	7.22±0.27	0.53±0.12	17.58±0.37
No amendments applied (excluding lawns)	Atlantic Central (n = 88)	0.017±0.001	0.168±0.010	7.59±0.42	0.47±0.06	18.36±0.61
	Atlantic North (n=24)	0.018±0.002	0.202±0.016	9.21±1.75	0.40±0.03	21.52±1.90
	Mean (n = 112)	0.017±0.001	0.175±0.008	7.94±0.50	0.46±0.04	19.04±0.63
Amendments applied (excluding lawns)	Atlantic Central (n = 209)	0.018±0.001	0.165±0.006	10.13±0.46	0.58±0.03	18.63±0.49
	Atlantic North (n=52)	0.018±0.001	0.199±0.011	10.50±1.02	0.50±0.04	20.76±0.83
	Mean (n = 261)	0.018±0.001	0.172±0.005	10.21±0.42	0.56±0.02	19.05±0.43