

IT'S A TEA PARTY

Introduction

Like the Soil Your Undies test, this is a quick and dirty way to test soil health and microbial activity on cropland, pastures, rangeland or forests. Rather than using underwear or cotton cloth, this test uses green and/or black teas. Green teas decompose quickly primarily by bacterial activity. Black teas are decomposed at a slow rate primarily by fungi. Soil microbes can decompose natural fibers, and comparisons of the weights before and after burying are an indication of microbial activity/decomposition. Microbes are most active at or near the surface making burying at the 3-inch (5-cm) depth a good depth to use. The greater levels of decomposition/deterioration (i.e. holes or partial openings) in the tea leaves and teabags, the healthier your soil/higher levels of microbial activity.

Supplies

- Data sheet
- Flag or flagging tape
- Image analysis software like Image J
- Kitchen scale – digital preferred
- Loose-leaf or bagged green and/or black teas (**teas**)
- Measuring tape
- Mobile device with camera and location services or camera and GPS system
- **Nylons** – knee-highs or pantyhose
- Paper
- Permanent marker, optional
- Pen or pencil
- Soil temperature probe, optional
- Shovel or garden trowel
- Tweezers

Preparing the nylons and teas

1. If needed, cut full-sized **nylons** into sections to bury the **teas** at different depths.
2. Use a permanent marker to label the **nylons** to avoid confusion particularly when weighing, taking pictures of and rinsing the samples.
3. If both ends of the **nylons** are open, tie one end to create a bag to hold the **teas**.
4. If loose teas are used, cut the leaves to similar sizes and weigh out a 2-ounce or 50-gram sample.
5. Take pictures of teabags or loose-leaf tea samples (**teas**).
6. Optional – Use image analysis with a program like Image J to measure the sizes of the tea leaves and teabag including teabag characteristics.
7. Place the **teas** in the **nylons**.
8. Weigh the **teas** in the **nylons** and record the weight.

Burying the tea

9. Dig a hole with a shovel 3-6 inches or 5-15 cm deep – try not to break up the soil structure.
10. Make the hole wide enough for the **teas** in the **nylons** lays flat on the bottom of the hole.
11. Use the measuring tape to measure the hole depth.
12. Record the depth and any soil, plant and management observations.
13. Place the **nylons** with the **teas** in the hole so **teas** lay flat on the bottom of the hole.
14. Take a picture with your mobile device or camera and use the location services or a GPS system to mark the spot.
15. Extend the **nylons** to the soil surface keeping the part of the **nylons** with **teas** on the bottom of the hole.
16. Fill in the hole with the soil removed to dig the hole – try to maintain the soil structure and keep part of the **nylons** on the soil surface.
17. If needed, mark the spot with a flag or flagging tape which may be tied to the **nylons** to make it easier to find later.

Unbury the nylons and teas and measure decomposition

18. After at least 35 days, carefully dig up the **nylons** containing the **teas**. (Note: 35 days during active plant growth is the minimum but the burial time may be extended to several months or up to a year depending on the amount of active plant growth.)
19. Take pictures of the **nylons** with the **teas** and note any soil and roots attached to the outside and growing into the **nylons**.
20. Gently remove the soil, roots and debris attached to the outside of the **nylons** with a tweezers.
21. Gently remove the teabag or tea leaves (**teas**) from inside the **nylons** and collect on a piece of paper.
22. Carefully remove roots, soil or soil aggregates from the teabag or tea leaves with a tweezers.
23. Turn the **nylons** inside out and remove any root pieces or other debris with a tweezers before turning it back outside out.
24. Take pictures of the **teas** removed from the **nylons**.
25. Optional – Use image analysis with a program like Image J to measure the sizes of the tea leaves or sizes of the tea leaves and teabag including teabag characteristics and holes in the teabag.
26. Put the **teas** back into the **nylons** by making the paper into a funnel or using the tweezers, weigh, and record weight.
27. Rinse by hand with ice cold water to remove fine soil particles attached to the **nylons** or **teas**. (Note – the tea may dissolve in the water but using ice cold water will make this less likely.) Rinse until the water dripping out is clear.
28. Air dry for at least 4-7 days to completely dry the **nylons** and **teas**.
29. Weigh the dried **nylons** with the **teas**, record the weight, and compare to the weight prior to burying (**Step 8**).
30. If the weight is higher than in **Step 8**, dry longer or wash by hand again with ice cold water and repeat **Steps 28-29**.
31. Gently remove the **teas** from the **nylons** with the tweezers, transfer to paper and take a picture. Compare the pictures from **Step 24** to this picture to see if any tea has dissolved.

32. Optional – Use image analysis with a program like Image J to measure the sizes of the tea leaves and teabag including teabag characteristics and holes in the teabag.
33. Compare pictures from **Steps 5, 24, and 31** to visually assess decomposition of the **teas** by microbial activity.

Calculating microbial activity by decomposition of teas

34. Use the differences in weight from **Steps 8 and 26 or 29** to calculate the percentage of **teas** lost according to the equation below.

$$\begin{aligned} & \text{percentage of } \textbf{teas} \text{ decomposed} \\ &= \left[\frac{\text{weight of } \textbf{teas} \text{ in } \textbf{nylons} \text{ before burying (Step 8)} - \text{weight of } \textbf{teas} \text{ in } \textbf{nylons} \text{ after unburying, rinsing and drying (Step 26 or 29)}}{\text{weight of } \textbf{teas} \text{ in } \textbf{nylons} \text{ before burying (Step 8)}} \right] \times 100 \end{aligned}$$

Optional tests

1. Bury **teas** in **nylons** at different depths to measure the differences in microbial activity at the surface compared to deeper in the soil. This may be done by putting several tea samples in one long nylon and tying the nylon above and below the individual tea sample at a particular depth which allows them to be connected in one nylon with only one hole being dug. Burying different **nylons** with **teas** at various depths individually also is an option.
2. Bury **teas** in **nylons** in the same field and unbury at different times every 30 to 60 days during the year.
3. Bury different natural materials including 100% cotton underwear, strips of cotton cloth, muslin, wool, hides, leather, bark, wood chips, roots, etc. Anything may be used if the material is 100% natural and hasn't been chemically treated or exposed to synthetic chemicals. (See Soil Your Undies test for additional details.)
4. This test may also be conducted in pots. Care needs to be taken when burying and unburying **nylons** with **teas** in pots to not destroy or kill the plants in the pot. The best way to do this in a pot would be to bury the **teas** in **nylons** when planting in the pot and unbury when harvesting or transplanting into a larger pot. Otherwise using large pots with enough room to bury and unbury the **teas** in **nylons**.

Observations/What's Happening

1. Observe what the soil looks like when digging the hole:
 - a. Soil structure – crumbly with soil aggregates and pore space
 - b. Compacted layers
 - c. Presence of roots, earthworms, insects, or other indicators of biological life
2. A higher percentage of **teas** decomposed as calculated in **Step 34** indicate more microbial activity.
3. A very low percentage of **teas** decomposed as calculated in **Step 34** may be inaccurate because heavier soil particles may not be removed during the rinsing process.
4. High percentage values from **Step 34** may be from **teas** dissolving in water during the rinsing rather than decomposition by microbes.
5. Use visual differences from the photos and image analyses of the numbers and sizes of holes tea leaves or teabags sizes to support the values calculated in **Step 34**.

6. More microbial activity and tea decomposition will occur when plants are actively growing.
7. Fungi decompose materials at a slower rate and will decompose more woody material (i.e. black teas) while bacteria act quickly. Most of the decomposition of green tea leaves will be performed by bacteria.
8. If other natural materials are used instead of teas, it should be noted that green leaves, crop residues including roots, and cotton cloths or underwear will decompose more quickly by bacteria. Wool, wood chips, bark, leather, and hides will be decomposed more slowly by fungi.
9. The time of year or growing season will impact microbial activity and decomposition rates with more activity during active plant growth.
10. Microbes are more active closer to the soil surface meaning materials will decompose more slowly the deeper the materials are buried.

Tips and Tricks

1. Use both flags or flagging tape and GPS to mark where you buried the **nylons** and **teas** or natural materials.
2. Measurements of soil temperature at the time of burial and removal would also be helpful in determining microbial activity and decomposition rates.
3. Laying the **teas** flat in the **nylons** in a single layer on the bottom of the hole is best to maintain even contact with the soil and microbes in the soil.
4. It may be difficult to dig up the decomposed teabags or other natural materials without them falling apart and losing material. Putting the **teas** in **nylons** will help retain the undecomposed pieces while not decomposing itself. (Nylon will decompose and break apart but it will take years).
5. When removing the **teas** from the **nylons** in **Steps 21** and **31**, this should be done over the paper to collect any bits of tea leaves or tea bags.
6. Turn the **nylons** inside out in **Step 23** to remove any roots, soil or soil aggregates over a piece of paper to collect any bits of tea leaves or tea bags.
7. Taking many pictures and notes will help in assessing differences between locations and microbial activity.
8. Comparisons could be made between fields, areas managed differently, different locations or soil types, or before and after management changes.
9. To better understand soil microbial activity, vary the time when the **teas** are unburied or the depths at which they were buried. If different times are used, the measurements may be used to determine decomposition rates over time.
10. As noted in the *Optional tests* section, you can examine the decomposition of different materials, crop residues, cotton cloth muslin cloth, hides, wood chips, or leather if the materials are natural and not treated.

References

1. <https://www.nrcs.usda.gov/state-offices/oregon/soil-your-undies-challenge>
2. <https://www.nrcs.usda.gov/state-offices/montana/soil-your-undies-challenge>