Soil-Biodegradable Mulches: *Workshop*

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Authors:
Carol Miles[1]
Huan Zhang[1]
Shuresh Ghimire[2]

[1]Washington State University
[2]University of Connecticut

Synopsis:
Presence of visible mulch fragments is a measure of the initial stages of mulch degradation, but is not a direct measure of the rate or extent of biodegradation.

Editors:
Carol Miles, Washington State University
Lisa DeVetter, Washington State University
Huan Zhang, Washington State University
Srijana Shrestha, Washington State University
Shuresh Ghimire, University of Connecticut

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USDA United States Department of Agriculture National Institute of Food and Agriculture

Soil Sampling for Visible Plastic Fragments Post Tillage

This workshop series provides slide presentations on soil-biodegradable mulches (BDMs). These notes provide additional information for presenters. Numbers in the text correspond to the slides in each presentation. Information in this document was summarized from publications listed in the Reference section.

1. This presentation provides information on methods and procedures for soil sampling for plastic fragments post-tillage.
2. Soil sampling is used to measure visible mulch fragments and is a measure of initial stages of mulch degradation. It is not a direct measure of the rate or extent of biodegradation. If PE mulch is in the soil, it is necessary to estimate its

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amount prior to BDM application. This sampling procedure does not distinguish between polyethylene (PE) and BDM.

3. Collect 5 representative soil samples from the field you wish to sample using an X or Z pattern. Each sample area should be 3 ft x 3 ft to a depth of 1/2 foot or to tillage depth. Place the excavated soil on a piece of plywood (≥ 4 ft × 4 ft). This procedure works well for loam-type soils.
4. Mix the soil thoroughly and spread it out on the plywood. Reduce the amount of soil in the sample using the quartering method: divide the soil into quarters by creating two lines intersecting at right angles at the center of the pile (Fig. 1). If plastic fragments are found in multiple quarters, divide the fragments and place them on the respective quarters (Fig. 2). Discard two diagonally opposite quarters (Fig. 1).
5. Re-mix the sample and carry out this quartering procedure a total of four times, so that the final sample size is 1/16 of the original sample size, which is approximately 2.5 gallons.
6. To recover mulch fragments from the soil sample, first dry the soil (Fig. 3A), then grind it with a heavy rolling pin (marble works well) (Fig. 3B). As you grind the soil, collect the plastic fragments and place them in a sealable plastic bag (Fig. 3C). Sieve the soil using the No. 8 sieve and place plastic fragments captured by the sieve into the bag. Place the plastic fragments in a large bowl or container (approx. 2 gal.), and rinse with tap water agitating gently by hand to remove any adhering soil. Pour the water out through the no. 10 sieve to capture the plastic pieces (Fig. 3D).
7. Place the clean plastic fragments from each soil sample in a labeled paper bag and air dry. Record the total weight of the mulch fragments in each sample after air drying. This requires a precision balance that can read 1 mg to 100 g (Fig. 4). Calculate the average weight of plastic per sample by dividing total weight by number of samples.

Figure 1. Quartering method of soil sampling.


Figure 2. Dividing the piece of mulch.

For example: The weight of plastic recovered in each of the 5 samples is 0.8, 1.2, 1.0, 1.1 and 0.9 g.
Total plastic recovered from 5 samples = 5 g
The weight of mulch/acre = 5 x 15,488[1] = 77,440 g = 77.44 kg

[1]See Table 1 for this multiplication factor, which is based on the number of samples.

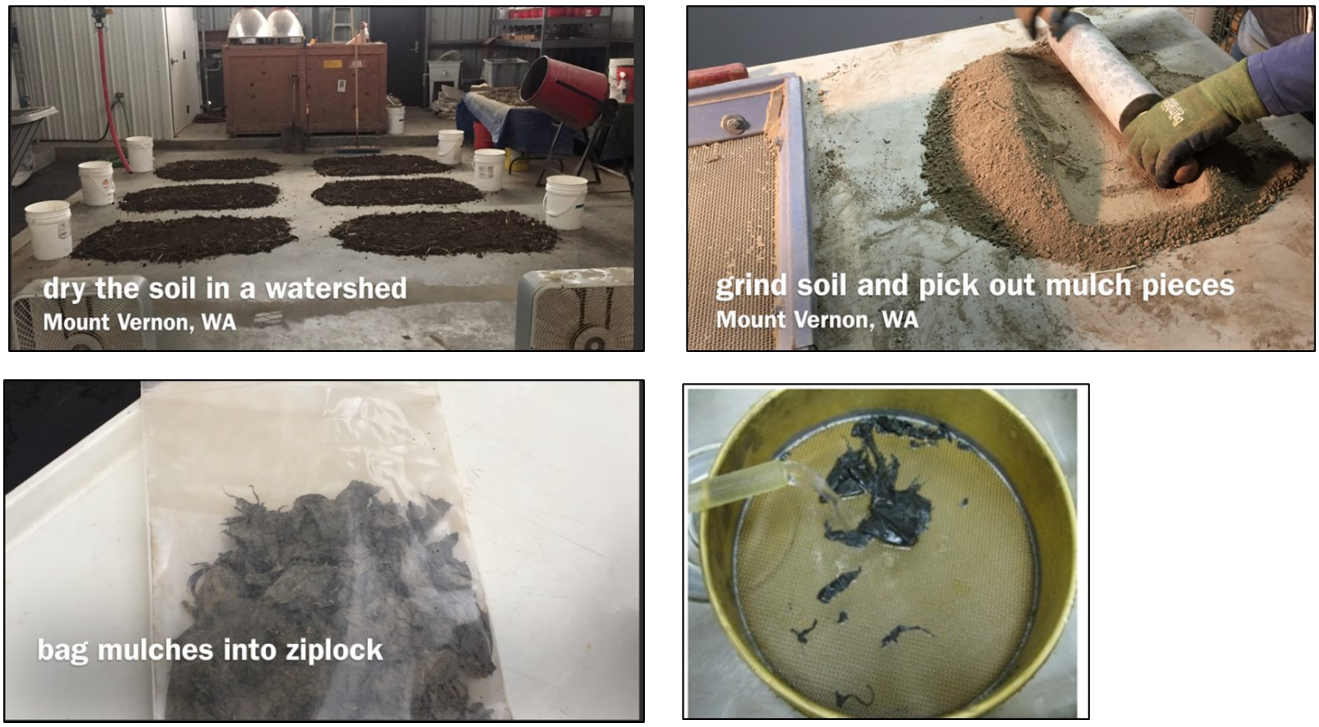

Figure 3. Process of recovering mulch fragments from soil sample.

Figure 4. Weighing of plastic mulch fragments in a precision balance.

Table 1. Calculation of the weight of recovered mulch per acre based on 9 ft² per soil sample.

No. of samples	Sample collection total area (ft²)	Multiplication factor for weight of mulch/acre[1]
3	27	25,813
5	45	15,488
6	54	12,907
7	63	11,063
8	72	9,680
9	81	8,604
10	90	7,744
11	99	7,040
12	108	6,453

[1]Calculated by dividing the number of ft² per acre (43,560 ft²) by the total area sampled (each sample area is 9 ft²) and multiplying by 16 (measured sample was 1/16 of 3 ft x 3 ft sample)

8. The multiplication factor for weight of mulch/acre is obtained by dividing the number of ft² per acre (43,560 ft²) by the total area sampled (each sample area is 9 ft²) and multiplying by 16 (measured sample was 1/16 of 3 ft x 3 ft sample).

9. Calculate the area of mulch from the weight of mulch using the following equation:

   - Total area of mulch per acre = weight of mulch / (density of mulch x thickness of mulch)
   - Mulch density: BDM = 1.37 g/cm³ and PE mulch = 0.94 g/cm³
   - Assumption of thickness of mulch: 1 mil = 0.00254 cm
   - Using the above example, recovered mulch per acre = 77,440 g / (1.37 g/cm³ x 0.00254 cm) = 22,254,152 cm² or 23,954 ft²

Resources

These information resources provide background information and additional information to help you have a more thorough understanding of this topic. We encourage presenters to view each one so as to be better prepared for your presentation.

Ghimire, S., M. Flury, E. Scheenstra, and C. Miles. 2019. Sampling and degradation of biodegradable plastic and paper mulches in field after tillage incorporation. Science of the Total Environment.
https://doi.org/10.1016/j.scitotenv.2019.135577

Soil sampling method to assess the amount of plastic fragments in the field

https://s3.wp.wsu.edu/uploads/sites/2181/2020/07/Soil-sampling-factsheet.pdf

Video – Soil Sample Methods

https://www.youtube.com/watch?v=o2TzGlZ6SCs&feature=youtu.be