

Biochar



When researchers at the Virginia Polytechnic Institute Agriculture Program, also known as Virginia Tech, started work on a soil enhancement research project, they kept their minds open. The project was focused on the possible uses of biochar, charcoal used specifically for agricultural and other environmental applications.

Biochar has been in use for centuries. Pre-Columbian Amazonians used it as a means to revive nutrient-depleted soil. They burned agricultural waste under a cover of soil in order to create a layer of biochar in the ground. The resulting product is called “terra preta”, or dark earth. Applying terra preta to this soil increased the agricultural yield of the land and enriched previously poor tribes and communities.

These Native Americans had discovered the benefits of using biochar as a soil amendment. When used in this way it doesn't only improve crop yield. It also improves water quality and reduces soil emissions of greenhouse gases, nutrients leaching, soil acidity, and irrigation and fertilizer requirements.

Biochar is still in use in South America. Scientists have learned that it is particularly good as a soil enhancement in areas with acidic clay soils and sandy soils. Biochar increases the soil's ability to attract and retain water. As a result, nutrients, phosphorus and agrochemicals are retained for the plant's benefit. Plants are therefore healthier and fertilizers leach less into surface or groundwater. Biochar is a useful carbon sequestration tool. The hope is that rural farmers in Brazil will switch from traditional slash and burn farming to slash and char.

So what does an ancient agricultural technology have to do with the scientists at Virginia Tech?

The researchers at Virginia Tech work in environmental science. Many of them also live in central Appalachia. Central Appalachia is mining country. For generations, the area has been mined for coal. More recently, mining companies have been using a technique called mountaintop removal. This means they take layers of rock and mineral off the top of the mountain in order to get access to the coal seams inside. The removed mountaintop, called overburden, is replaced on the ridge and compacted to replicate the original mountain shape. Energy and environmental industry officials call these areas post-mined land.

Post-mining sites are difficult to reclaim. The resulting soil is highly acidic and infertile. The post-mined compacted soil proves more difficult to seed. The soil needs to be loose and open in order for seed to get into the soil. In post-mined land, the ground is too compact. Post-mining sites, therefore, typically look very different from the surrounding area. These sites are more likely to be home to invasive botanical species. Residents and environmental activists complain the landscape is ruined, that the mountain terrain is scarred.

Even if no new permits for mountaintop removal mines are issued, the problem of how to reclaim the post-mined sites remains. Researchers at Virginia Tech decided to try using biochar to help reforest the post-mining site soil. They got permission to apply a layer of biochar to a post-mining site before it was reseeded and replanted. What the team found was that the biochar worked, but not as well as they had hoped. Soil samples showed the biochar had improved the chemistry of the soil. But not enough biochar had been added to make a serious difference. Researchers learned they would have to seriously up the amount of biochar they applied to the site. The kind of biochar the team used, however, was expensive. It cost about \$1,000 a ton. Ten tons per acre, the amount the researchers applied, wasn't enough biochar to make a significant improvement to the soil conditions across the site.

The research project had a practical constraint. The team was looking for a solution to the problem of post-mining land. If the biochar was going to cost a small fortune, it would not be feasible for local government or nonprofit groups to use in such large amounts.

The team went back to the drawing board. They redesigned the biochar tests by increasing the concentration of biochar in specific locations. In other words, the team created “planting cells” of biochar-enhanced soil on the post-mining site. Within these “cells” the soil recomposed itself quickly and well. The team had created healthy soil in which saplings could grow. Many trees die on post-mining sites, so improving the chances for individual trees to survive was a good result.

The team would have rather seen the same results with a small amount of biochar spread across the post-mining site. But getting some improvements, given the financial constraint, was better than nothing.

Happily, researchers working with biochar learned that its physical properties would make it ideal for working with other environmental problems. They hypothesized that the material would be useful in treating the biosolids that come from municipal waste, in other words, the sewage of urban areas. Urban waste is, in many areas, dumped into fields outside the municipality, creating zones that smell bad and can't be used for other purposes. The municipal waste is very wet and the biochar is very dry. Researchers hypothesized that biochar can be added to coat the waste to create a product that can be spread as fertilizer. In the process, the biochar reduces the smell of the waste and helps reduce greenhouse gases. Early studies show they are correct; biochar can be used in this way.

Name: _____ Date: _____

1. What is biochar?

- A a specific type of municipal waste
- B an ancient agricultural technique that was recently discovered
- C charcoal that is used for agricultural and other environmental applications
- D a mining technique that removes layers of rock and mineral from mountaintops

2. What does the author describe in the passage?

- A past and present uses of biochar
- B pre-Columbian Amazonian social customs
- C famous research projects at Virginia Tech
- D protests against mountaintop removal mining

3. Plants are healthier when seeded in soil that has been treated with biochar. What evidence from the text supports this conclusion?

- A "Scientists have learned that it is particularly good as a soil enhancement in areas with acidic clay soils and sandy soils."
- B "Biochar increases the soil's ability to attract and retain water. As a result, nutrients, phosphorus and agrochemicals are retained for the plant's benefit."
- C "Biochar is a useful carbon sequestration tool."
- D "The hope is that rural farmers in Brazil will switch from traditional slash and burn farming to slash and char."

4. Why are post-mining sites likely to be home to invasive botanical species?

- A because the soil has been imported from a foreign site
- B because the act of mining introduces invasive plants to the soil
- C because the post-mined soil is too loose for native plants to seed
- D because the original acidity and density of the soil has been altered

5. What is this passage mainly about?

- A mountaintop removal mining in central Appalachia
- B a soil enhancement research project using biochar
- C the use of biochar in South America
- D the problems of urban sewage removal

6. Read the following sentences: "If the biochar was going to cost a small fortune, it would not be feasible for local government or nonprofit groups to use in such large amounts. The team went **back to the drawing board**. They redesigned the biochar tests by increasing the biochar in specific locations."

What does it mean to "go back to the drawing board" in this context?

- A continue with the same experiment
- B slightly change the current experiment
- C design a new experiment
- D give up on the experiment altogether

7. Choose the answer that best completes the sentence below.

Pre-Columbian Amazonians applied terra preta to the soil before planting crops; _____, they were able to increase the agricultural yield of the land.

- A consequently
- B moreover
- C even though
- D for instance

8. What is mountaintop removal mining?

9. What problem did the researchers from Virginia Tech encounter during their attempt to reforest post-mined soil using biochar?

10. Was the Virginia Tech soil enhancement research project a success? Why or why not? Support your argument with examples from the text.
