Just How Renewable Is It?

The Sustainability of Peat as a Microbial Carrier

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So what is peat, anyway?

Peat is partially decomposed plant matter. In general, peat is found in water-saturated areas where vegetative decay is hindered by climate and lack of oxygen. Over long periods of time, the plant matter accumulates to form a deposit. Although peat can be found world-wide, those deposits cover vast areas of the northern hemisphere and have historically been viewed as valuable natural resources.

There are two major types of peat: *Sphagnum* and reed-sedge. The names reflect the parent plant material that makes up the peat. *Sphagnum* is the most common type of peat and is sold under various names including peat moss and *Sphagnum* moss. It is largely sold into the horticultural market as a soil amendment and can be found in nearly every home improvement outlet.

Reed-sedge peat is less well known. There are a number of characteristics that make reed-sedge peat an attraction substrate for microbial growth. First, the pH of reed-sedge peat is generally closer to neutral than *Sphagnum*, making it a more friendly environment for microbial growth. Also, reed-sedge peats tend to have less fibrous material and more closely mimic the humic substrate found in field soils. Lastly, all peats are known for their ability to retain water. This is a critical characteristic for keeping microbial organisms viable during period of dry conditions.

Since 2003, American Peat Technology (APT) has been producing reed-sedge peat media for use as carriers of agricultural microorganisms. The bulk of the media is sold as a carrier for rhizobia. Rhizobia are nitrogen-fixing bacteria that form symbiotic relationships with legume plants. Other, on-going research is exploring the use of peat-based carriers to deliver fungicidal bacteria, to enhance growth of mycorrhiza, and as a growing medium for mushrooms and beetles

Is peat a renewable resource?

At the heart of the debate about using peat is the question of whether or not peat is a renewable resource. Much of the industrialized world classifies peat as a non-renewable resource, although the Intergovernmental Panel on Climate Change in 2006 changed its classification of peat from a fossil fuel to a new and separate category between fossil and renewable fuels. The IPCC simply calls this new classification “peat”, which seems to be a recognition of the unique nature of the resource. Certainly peat is not the product of millions of years of formation like petroleum. Yet a deposit of peat requires more time to accumulate to maturity than, say, a hardwood forest.

The research is limited and varied about just how renewable peatlands are. Climate and latitude, plant species, regeneration techniques and hydrology all play critical roles in how quickly bare peatlands can be restored to net producers of peat. To complicate the issue, the role of peatlands –whether pristine, under production or revegetated – in carbon sequestration and greenhouse gas production is also dependent on many factors. This is not a question that is easily and quickly answered.

However, there are several elements in the discussion that require further clarification. First, the current discussions about peatlands generally start with the assumption that peat is an energy source. Once peat is being considered as a combustible fuel, the concerns about regeneration are understandable. Peat has a calorific value of about 15,000 kJ/kg. Compared to the calorific value of natural gas, which approaches 43,000kJ/kg, it requires an inordinately large amount of peat to replace fossil fuels. In that scenario, which requires the deforestation and harvest of enormous tracts of peatlands, we simply must ask the questions about sustainability. Additionally, the horticultural community has raised the issue of sustainability when discussing the use of peat or peat products such as *Sphagnum* moss. In that application, peat is a luxury commodity that can be replaced with far more renewable products.

Second, the discussions about peatland restoration generally assume that restoration is not complete or valuable until all the characteristics of the original tract are restored. The fact is, peatlands that have been cleared of vegetation but retain a base layer of peat can be valuable in many ways other than the production of peat. Their value for timber production and agriculture is generally not considered, but can have real impact on the surrounding environment and economy. Having said that, it is nonetheless possible to return a harvested peatland into a net producer of peat. What is in question is the length of time it takes to achieve that state. Estimates range from 5 to 100 years.

If the natural resource is taken as a whole, is peat renewable?

The data are varied and contradictory when considering the sustainability of peat harvest on a global scale. In northern Europe, where peat is used as a fuel, peat harvest and use appears to be exceeding accumulation. The picture is more encouraging in North America, where the peat resources are either harvested for horticultural use or used *in situ* as agricultural land, and accretion rates are almost certainly exceeding losses. It is difficult to accurately quantify accumulation of peat because the rates of deposition are variable from site to site and from year to year.

How much peat is APT using?

American Peat Technology is currently harvesting reed-sedge peat from a 160-acre site located about a mile from our processing plant in central Minnesota. The harvest site is part of an expansive bog that was tiled and drained in the 1920's and converted to agricultural fields.

The harvest of the deposit starts during the summer months when the top layer of peat is skimmed off and pushed into windrows. In winter, once the site has frozen and can support truck traffic, the windrows are loaded and transported to the processing plant.

At current production levels, the deposit contains enough peat for 300 years of production. As the demand for our products grow, however, we obviously anticipate a reduction in that projection. As with all peat harvesting operators, we hold a permit from the U.S. Army Corps of Engineers. Our permit allows the harvest of peat to a depth of 84 inches and requires remediation of the site once our harvest operation is completed.

Until recently, the research regarding peat focused largely on the exploitation of the resource. Not surprisingly, there is not a wealth of information about how to restore a peatland to its original state. When the time to stop harvest on our existing site arrives, APT will use the best available technology to remediate the site and has already started to plan for staged restoration. We have a reputation for cooperating with researchers and regulators, and we expect to maintain those connections through the restoration process.

How should the peat resource be used?

One of the factors to contemplate in the discussion about sustainability is the concept of best use. As mentioned above, peat is not ideal as an energy source. Fossil fuels and renewable sources are more favorable options when evaluating energy production compared to environmental cost. The worldwide concern about diminishing peat reserves is heating up, largely as a result of the climate change discussion, and the move to discourage peat as a fuel is gaining momentum in policy changes and public opinion. Simply stated, peat is too valuable to be used as a marginal source of energy.

Peatlands and the role they play in carbon sequestration and climate change is another subject to consider in the discussion about best use. The balance between carbon dioxide and methane, peatlands and increasing global temperature is complex, but the general consensus is that undisturbed peatlands act as carbon sinks. Certainly, peatlands that have their original hydrology intact are efficient filters of toxins, temper water fluctuations and provide wildlife habitat.

Human impact on the planet is inevitable, but using a resource is not necessarily analogous to destroying it. That peatlands are a critical part of the planet's ecosystem and need to be protected is widely understood. How we can use those peatlands in ways that are judicious and strategic is a topic for education and discussion.

The use of peat as a microbial carrier appears to be a sustainable and beneficial use of the resource, but all these factors need to come into play as we continue the conversation about how to best use the natural resources around us in a sustainable, thoughtful way. In the end, that debate may ultimately serve to benefit both us and the environment.

Why do we need microbial carriers?

In many cases, microbial carriers augment natural processes. For example, rhizobia, the nitrogen-fixing bacteria that enhance legume crops, are naturally found in soils. As the legume seed germinates, the bacteria enter the root hairs. In response, the plant develops nodules on its roots. The bacteria colonize the nodules and draw energy from the growing plant while they convert atmospheric nitrogen into biologically available ammonia. This symbiotic relationship not only benefits the rhizobia and legume, it enhances the nitrogen content of the surrounding soil. Generally, however, native rhizobia are not found in numbers to adequately support crop growth. Or, the native rhizobia may not be a good match for the type of crop, resulting in poor or no symbiosis.

Adding the correct rhizobia into the soil at the same time as seeding a legume crop acts like a fertilizer. A well-matched inoculant eliminates the need for additional nitrogen inputs during the growing season. That translates into fewer chemical, labor and energy inputs in the crop.

Other uses for microbial carriers may not be as elegant as the rhizobia inoculant example. Nonetheless, when microbiology meets agronomy, the application of microorganisms for crop enhancement and pest control often requires a carrier medium. Considering the world's growing need for agricultural products, the use of carrier media will only increase as the scientific community seeks out ways to deliver safe, economical solutions to the issues that threaten the world's food supply.

What are the options for microbial carriers?

The job of a microbial carrier is deceptively simple: deliver viable microorganisms at the right time to the right place. The best carriers do that by having these essential characteristics:

- Sterile or semi-sterile
- Physically uniform and easy to deploy
- Able to retain water in arid conditions
- Accepts additional nutrients
- Low-cost
- Non-toxic and biodegradable
- Retains its characteristics while stored and transported

The type of material used in carriers is varied. Carriers can be manufactured from, for example, waste ash, biochar, gypsum, vermiculite, coal, clay, plant waste and polymers. Peat, however, is the industry standard for microbial carriers for rhizobia because of its ability to meet and exceed the standards listed above.

Peat has a number of additional qualities that make it an attractive carrier media. First, the humic substrate of the peat mimics the surrounding soil, which reduces the shock as the bacteria make the transition from carrier to root hair. Simply put, fewer rhizobia die during the trip. Secondly, peat is an organic material, and adding organic amendments is a good idea for most soils. Even though the annual amount of peat added is small, it is certainly not a detriment to the soil. Last, American Peat Technology produces a granular peat media, as well as the more common powdered form. Between the two options, most planters can be adapted to accommodate the carrier without the need to replace expensive equipment.

Like a balance sheet, our accounting of the use of natural resources has pluses and minuses. Undisturbed land is a rare gem, but we need farmland to produce food. We all desire clean air, but we also need electricity to power our homes. No one wants to live by a strip mining operation, but we need steel to build the infrastructure of society.

Healthy populations of microorganisms, although we often take them for granted, support life on the planet. In some cases, as in rhizobia, colonies of microbes could be replaced by chemical additions, but we know from past experiences that natural solutions are generally preferred over artificial ones. Using peat-based carriers to introduce and support beneficial microorganisms has a two-fold benefit: it makes use of a renewable, natural product to enhance the natural processes already at work in the soil.

American Peat Technology is committed to an on-going effort to better understand the processes of peat deposition and regeneration. We understand that we are stewards of the peat deposit that we are harvesting. With careful management and judicious use of the resource, we can meet the challenge of sustainability for many more years.

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