American-Israeli scientist recognized for excellence in biochar research by Volcani Center

Charcoal from biomass could reduce greenhouse gases, improve plant health

• By SHARON UDASIN

For Dr. Ellen Graber, researching the carbon-rich black substance known as biological charcoal – or "biochar" – is her humble contribution to the global fight against climate change.

Graber, an American-Israeli transplanted from New York, received the "Scientist of the Year" award for 2013 on Monday morning from the Academic Committee of the Volcani Center, the Agriculture Ministry's research arm, for achievements in the ever expanding field of biochar – charcoal created through the pyrolysis, or thermochemical decomposition, of biomass.

Founder of the Israel Biochar Research Network, Graber is a researcher with the Volcani Center's Institute of Soil, Water and Environmental Sciences in Beit Dagan. Her entrance to the field stemmed from a desire to explore the possibilities of biochar for mitigating greenhouse gas emissions in the face of climate change, and for improving soil fertility.

To generate energy-rich products like solid biochar or gaseous biofuels, researchers are tasked with decomposing and carbonizing biomass through a pyrogenic process. Biochar can be for energy, but Graber's research primarily focuses on the use of the product as a soil amendment, with fertility-enhancing properties.

"It's a really new field," Graber told *The Jerusalem Post* on Monday, adding, however, that researchers around the world were now fervently working on the subject.

Because the half-life of biochar in the soil is hundreds to thousands of years or more, the sequestration of the carbon that originated in the atmosphere as CO_2 ends up sequestered in the soil essentially permanently – a carbon-negative process, researchers have found. It might have many benefits to soil, such as boosting plant growth, improving water-holding capacity, reducing nutrient leaching, reducing soil acidity, increasing water retention and reducing irrigation and fertilizer requirements, Graber explained.

While Graber sees an important future for biochar – what she calls the "biochar vision" – she cautions that the product is still in its infancy and cannot be recognized as a "magic bullet" for all climate and soil issues. Moreover, there are still many unknowns involved in how to use it, at what dosages, in what cropping systems and in what types of soil, she explained.

There are also a number of economic and technological uncertainties at this time.

"From a scientific perspective it's amazing," she said. "Maybe it will fulfill its potential. If it does, it's one of a number of strategies that will need to be employed. It's not going to be standalone."

Biochar can improve plant performance and health by making them stronger and more disease resistant – which could potentially lead to a reduced need for pesticides or nutrient additions through fertilization, Graber posited. Meanwhile, due to its ability to sequester carbon, it has the advantage of being able to permanently remove carbon dioxide from the environment.

In addition to all the positive impacts of biochar, one particular element that scientists will need to focus on along the way are the negative effects it might have in the soil, particularly as it remains there for hundreds to thousands of years, Graber explained.

"We need to start small and then see what happens," she stated.

DR. ELLEN GRABER poses in the greenhouse she uses for research. (Courtesy Ellen Graber)

Graber and her research team at the Volcani Center are working with biochar under conditions in which obviously positive effects – like nutrient and water content – are controlled for in order to determine if plants are developing better simply from the biochar.

"This is what we call the delta, the biochar effect, that we're interested in," she explained.

In addition, she said her laboratory was the first in the world to discover that adding biochar to soil might improve system-wide immuno-defenses in plants.

Going forward, some of the research in the field that Graber has identified as still lacking includes pinpointing mechanisms as to how biochar affects soil tilth and crop yields, evaluating agronomic values of biochar use, estimating changes in water-use efficiency, assessment of biochar value to intensive and extensive agriculture, quantifying carbon sequestration and energy production, finding engineering solutions for pyrolysis, identifying different wastes that can be treated by this method and determining optimal pyrolysis conditions.

Her laboratory in particular is looking to identify how biochar impacts tilth and yields, as well as plant health, and how well it can help remediate contaminated soils. They are researching, for example, how it can tie up contaminants and prevent them from being mobilized in places like urban brownfields. The biochar can perhaps improve the soil by removing the toxins and enabling future plant growth, she explained.

"I also see this as a good start for biochar because, anyway, these soils are dead," she said. "So if I can rejuvenate them, that would be great."