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Careful guidance needed for farmers using biochar with pesticides

Biochar is increasingly mixed into farm soils to improve crop productivity and maintain carbon stocks. However, it can change the way that pesticides applied to the same soil behave, according to a new study. The researchers suggest that farmers may also need to follow new guidelines on pesticide application if they add biochar to their soil.

Biochar is a carbon-rich, charcoal-like substance made by heating biomass to very high temperatures for around one or two days at a time. It is sometimes described as a "soil conditioner" because it can improve soil quality. Its benefits appear to be greater in weathered, tropical soils, such as those in sub-Saharan Africa and Northern Australia.

Biochar has also been promoted as one of the most plausible and widely applicable methods for carbon sequestration. The Kyoto Protocol on Climate Change of 1997 makes allowances for carbon sequestered in soil in national carbon inventories. Because biochar is thought to remain in the soil for hundreds or potentially thousands of years, it could act as a large carbon sink and have a significant impact on net carbon emissions calculations.

Establishing how biochar interacts with other chemicals used in farming is important in weighing up the benefits and drawbacks of biochar's practical use. The study investigated, for the first time, the interactions between biochar and pesticides in the soil, focusing on the widely used herbicide simazine, which is representative of a whole class of pesticides called the triazine herbicides.

The researchers tested two different types of commercially produced biochar – one Australian product made from eucalyptus and one British product made from ash and beech – in low fertility (Australian) and high fertility (Welsh) soils. They studied the effects of adding biochar to soil on how simazine decomposed, how it spread through the soil and how much pesticide was leached.

Pesticides bind to biochar in the soil, reducing the spread of the chemicals and increasing concentrations in some "pesticide hotspots". This means that pesticides are likely to build up on the surface of soils and may pose a greater risk to soil mesofauna, such as earthworms and mites. However, the researchers say biochar is unlikely to have toxic effects on animals and that using larger particles would reduce the risk. In the study, biochar also reduced the downward movement of pesticides in response to artificial rainwater, thus potentially reducing the risk of groundwater contamination. Importantly, the effects of biochar on pesticides depended on the type of biochar used and the soil. For example, more simazine tended to leach from high fertility soil or if the biochar had small particles (diameter of less than 2mm), as per the eucalyptus biochar.

Overall, the results suggest a net beneficial effect of adding biochar for the behaviour of pesticides. However, in the case of pesticides which act at the soil level, activity will be reduced by becoming bound to the biochar and farmers may need to increase pesticide application in order to produce the same results. For the other types of pesticides which act above the soil level, this would not happen. The researchers recommend pesticide manufacturers produce "strong guidance" on how to apply pesticides to biochar-containing soil in order to prevent farmers from over-applying and the resulting negative effects on the environment.

Source: Jones, D.L., Edward-Jones, G., Murphy, D.V. (2011). Biochar mediated alterations in herbicide breakdown and leaching in soil. *Soil Biology & Biochemistry*. 43: 804-813.

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