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Review of 55 Studies Finds Vineyard-Pruning Biochar Needs Carbon Credits to Break Even

Researchers say the waste-derived material may help soils and lock up carbon, but direct vineyard field evidence remains limited

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A review published in Advances in Environmental and Engineering Research found that turning vineyard pruning residues into biochar could help improve soils, store carbon for long periods and support more circular use of waste in winegrowing, but it also said

the evidence base remains thin and the economics are weak without added revenue such as carbon credits.

The paper examined 55 sources on the use of biochar made from vineyard pruning residues, the woody material removed from vines during routine pruning. Biochar is a carbon-rich material produced by heating biomass under low-oxygen conditions. It has drawn attention in agriculture because it can put organic waste to use while potentially improving soil conditions and locking carbon into a more stable form.

According to the review, the main promise of biochar from vineyard prunings lies in three areas. The first is soil productivity, where biochar may help support water retention, soil structure and nutrient management. The second is long-term carbon sequestration, since part of the carbon in the original plant material can remain in the soil for extended periods after conversion to biochar. The third is circularity in viticulture, because a residue that is often treated as waste can instead be processed into a product used within the same production system.

But the authors also said the available research does not yet provide enough direct field evidence for strong conclusions about this specific material. The review noted a lack of field trials using biochar made from vineyard pruning residues themselves, rather than results drawn from biochar produced from other feedstocks. That gap matters because biochar performance can vary depending on the original material and the way it is produced.

The paper said that using findings from other kinds of biochar may lead to overgeneralization. In practice, that means growers and researchers should be cautious about assuming that results obtained with forest residues, crop waste or other biomass will apply in the same way to vine prunings. The review points to a need for more trials under real vineyard conditions, including longer-term studies that track both agronomic results and carbon outcomes over time.

The economic picture in the review was also restrained. A revised analysis cited in the paper found losses when no revenue from carbon credits was included. That suggests that, even if the environmental case is promising, the business case for producing biochar from vineyard prunings may remain difficult under current conditions if projects

depend only on direct farm or operational returns. The finding adds to broader questions facing carbon-removal and waste-valorization projects in agriculture, where equipment, processing and logistics costs can weigh heavily on adoption.

The study is likely to be closely watched in the wine industry, where producers face pressure to cut emissions and manage agricultural residues more efficiently. For wineries and other beverage companies that source from vineyards or invest in sustainability programs, the review offers a more cautious framework for judging projects built around pruning waste and carbon storage. It suggests that claims about soil benefits or climate gains should be tied to evidence from vineyard-pruning biochar itself, not assumed from other materials, and that any financial projections may depend heavily on whether carbon-credit income becomes available.

The review does not dismiss the technology. Instead, it presents biochar from vineyard prunings as a potentially useful tool whose environmental value still needs stronger field verification and whose commercial viability may depend on policy support, carbon markets or other incentives. That conclusion leaves room for further development, but it also signals that the path from pruning residue to profitable climate solution is not yet established.