United States Department of Agriculture

Natural Resources Conservation Service

CONSERVATION PRACTICE STANDARD

SOIL CARBON AMENDMENT

CODE 808

(ac)

DEFINITION

Using carbon-based amendments to increase soil carbon and improve the physical, chemical, and biological properties of the soil.

PURPOSE

This practice is used to accomplish one or more of the following purposes:

- Maintain, increase, or improve soil organic matter quantity and quality
- Maintain or improve soil aggregate stability
- Maintain or improve habitat for soil organisms
- Improve plant productivity and health
- Improve moisture management and the efficient use of irrigation water
- Improve air quality by reducing emissions of particulate matter (PM) and PM precursors, GHGs, ozone precursors and airborne reactive nitrogen.

CONDITIONS WHERE PRACTICE APPLIES

This practice applies to all land uses where organic carbon amendment applications will improve soil conditions, with the following exceptions:

- Do not use this practice to apply amendments to native grasslands or other areas where any resulting changes in the plant community would be undesirable
- Do not apply amendments to fields where nutrients in the amendment will not be utilized (*e.g.* fallow land or fields without an existing or planned cover crop or cash crop)

CRITERIA

General Criteria Applicable to All Purposes

Evaluate soils using appropriate planning criteria and assessment tools for the intended land use to determine where soil organic carbon amendments will improve the soil condition.

Take a recent soil test (within 1 year of amendment application) to assess the soil organic matter content of the soil prior to application of the organic soil carbon amendment.

The term “organic carbon amendments” refers to carbon-containing amendments derived from plant or animal residues and is not specifically related to the USDA National Organic Program or organic crop production methods.

Plan, design, and implement carbon amendment applications in compliance with all federal, state, and local laws and regulations. The owner or operator is responsible for securing all required permits or approvals and for applying the amendment in accordance with such laws and regulations.

Document physical and chemical amendment analysis. If the supplier does not provide an analysis, test the material using an appropriately credentialed laboratory prior to application.

Where contaminants such as metals or herbicides are expected to be significant, analysis should include testing for those.

For operations following USDA's National Organic Program, apply and manage amendments according to program regulations.

Calculate total N and P applied with the amendment. Do not apply at rates that exceed the plant total N or P removal rates for the next crop.

Assess surface and groundwater risks using the Idaho Nutrient Transport Risk Assessment (INTRA) prior to the application of amendments. As per Idaho NRCS Conservation Practice Standard (590) requirements all risks identified in INTRA as high or very high must be mitigated.

Apply at a rate that will improve the soil condition and address the resource concerns without creating unacceptable risk of N or P loss during a single application.

Time application of amendments and, where applicable, crop planting dates so that mineralization or immobilization of nutrients corresponds to crop nutrient needs.

Amendments with C:N ratios greater than 30:1 can immobilize nutrients, especially nitrogen, and may necessitate supplemental nitrogen applications for plant growth. Amendments with C:N ratios below 20:1 are likely to mineralize N and should be used at a time when crop N demand will prevent N leaching or denitrification to oxides of nitrogen (NOx).

Do not mix amendments with uncomposted manure or use amendments that have been pre-blended with soil. Do not use this practice for teh application of amendments containing biosolids or sewage sludge, or for the application of inorganic amendments such as limestone.

Do not operate heavy equipment on soils during wet conditions.

Do not apply amendments:

- During high wind events
- To frozen or snow-covered fields, or when the top 2 inches of soil are saturated
- To slopes greater than 8% on rangeland or forestland
- To slopes greater than 15% on cropland or pasture without mitigating surface water quality fun-off risks identified in INTRA. If organic amendment is incorporated erosion rates must remain below the soil losss Tolerance (T)..
- To sensitive areas, such as: wetlands, karst sinkholes, vernal pools, hydric soils, or naturally low fertility sites (*e.g.* serpentine soils, sage steppe, alkali sink or chaparral)
- Where the area will not be vegetated for longer than 3 months following application, or where nutrients from the amendment will cause leaching or runoff loss and water quality concerns

Compost: Use compost that meets the following criteria as determined by the Test Methods for the Examination of Composting and Compost (TMECC), or by Land Grant University (LGU) recognized methods:

- Carbon to nitrogen ratio (C:N) greater than 10:1 at maturity
- 25-60% moisture (75-40% solids) at maturity

Compost analyses must also report the carbon and nitrogen content, phosphorus, potassium, pH, soluble salts (electrical conductivity), dry matter, and bulk density on an “as-is” basis.

Base all compost analyses on reprasentative samples which are taken according to local land grant university guidance.

Use laboratories successfully meeting the requirements and performance standards of the US Composting Council’s Seal of Testing Assurance Program (STA), or use an alternative NRCS- or State-approved certification program that considers laboratory performance and proficiency to assure accuracy of laboratory analyses.

Do not apply compost when a phosphorus risk assessment indicates a high or very high risk for phosphorus transport without mitigating for the identified risks. (Note: Idaho’s phosphorus risk assessment is contained in the Idaho Nutrient Transport Risk Assessment - INTRA.

Biochar: Use biochar that is produced by heating biomass to a temperature in excess of 350°C under conditions of controlled and limited oxidant concentrations to prevent combustion (pyrolysis or gasification).

Biochar analysis must report:

- Country of origin of biochar and feedstock, and feedstock composition
- Production method (*e.g.* verification of temperature and limited oxygen conditions)
- Organic carbon, ash, nitrogen, pH, EC, liming equivalent, phosphorus, potassium, and pH of the final material.

Use laboratories successfully meeting the requirements and performance standards of the International Biochar Initiative (IBI) Seal or use an alternative NRCS- or State-approved certification program that considers laboratory performance and proficiency to assure accuracy of laboratory analyses.

Do not use biochar produced from:

- Crop residues that could otherwise be left on the field to provide soil protection and improve soil organism habitat, or
- Woody residue needed to sustain forest health and wildlife habitat referenced in NRCS CPS Forest Stand Improvement (Code 666).

Other Carbon Amendments (Needs Idaho NRCS State Agronomist Approval): Use regionally appropriate carbon-based materials, such as wood chips, pulverized paper, bagasse, coal ash, wood ash, or distillation residue to meet the conservation objective. Consult appropriate land-use specialists for assistance to plan for a specific conservation objective using alternative carbon amendments.

Ensure that materials are tested to identify any contaminants, and that supplemental N is applied as needed to avoid nutrient imbalances that may result from nitrogen immobilization with high C:N amendments.

Whole Orchard Recycling (WOR): Chip and incorporate orchard trees in place in the field in which they were grown. Do not export wood chips off site.

Distribute wood chips evenly and incorporate into the soil to a depth of at least six inches. WOR is applicable only to orchard trees, not to vineyards or bush crops. Use WOR in orchards where it will not pose an increased risk for disease, or where an increased risk of disease is managed by excluding diseased biomass or using similar cultural practices.

Additional Criteria to Improve Aggregate Stability

Apply amendments with minimal soil disturbance.

Additional Criteria to Improve Air Quality by Reducing Emissions of Oxides of Nitrogen (NOx) and Particulate Matter (PM) or by Reducing Emissions of Greenhouse Gases

Utilize whole orchard recycling on orchards greater than 10 years old as an alternative to agricultural burning to reduce emissions of NOx, PM, and GHG's. After incorporating wood chips into the soil, avoid creating anaerobic conditions by overwatering or by allowing ponded water, which could result in methane emissions.

To minimize fugitive PM emissions, do not apply soil amendments, operate chipping machinery, or disturb the soil during high wind events.

Additional Criteria to Improve Moisture Management and the Efficient Use of Irrigation Water

Ensure amendments will not introduce excessive salts and will not negatively affect soil water dynamics.

CONSIDERATIONS

General Considerations

When applying amendment to cropland where it will also serve as a nutrient source, apply amendments with C:N less than 20:1 to optimize nutrient availability for crop uptake.

Mix biochar and compost together prior to applicationto supply nutrients to nutrient-poor biochars and equilibrate nutrient interactions in the soil.

Using compost or biochar with the US Composting Council's Seal of Testing Assurance Program (STA) or the International Biochar Initiative (IBI) Seal, respectively, may serve as an expedient alternative for amendment validation.

Where Whole Orchard Recycling is applied, large amounts of high C:N material incorporated as wood chips may result in nitrogen immobilization and low N availability for a following crop. Soil testing is recommended to ensure that adequate N is available for crop planted following Whole Orchard Recycling.

Apply biochar that contains more than 60% carbon to reduce nitrogen or phosphorus losses. Test the product on small acreage prior to widespread use.

Consider using set maintenance application rates that would meet the conservation objective, avoid any negative nutrient interactions, and reduce planning time.

Take appropriate measures to prevent soil erosion and compaction.

Where material is trucked onto land, timing of traffic must minimize potential soil compaction, and traffic routes must be closely examined to ensure that erosion is not caused and that vehicles do not spread noxious or invasive seed. Disturbed areas should be appropriately treated to minimize potential erosion.

When applying the amendment to the surface on cropland, review NRCS CPS Mulching (Code 484) to ensure the best standard is selected for the intended purpose.

Where salinity poses soil health issues, ensure that amendments do not contribute further salts.

Consider using diesel-powered equipment and vehicles powered by Tier 3 or Tier 4 emissions certified diesel engines to minimize NOx and PM emissions from diesel exhaust.

When applying amendments that may contain pathogens (e.g. biological soil amendments of animal origin including manure, composted manure, composted carcasses, etc.), consider potential contamination pathways to produce crops typically consumed raw, food contact surfaces, water distribution systems, and other soil amendment sources where it could become a potential source of contamination.

Soil organic carbon loss is related to the volume of soil disturbed, intensity of the disturbance, and the soil moisture content and soil temperature at the time the disturbance occurs. To make this practice more effective at reducing carbon loss:

- Perform any deep soil disturbance, such as ripping, subsoiling or fertilizer injection, so the vertical slot created by the implements is closed at the surface.
- Plant with a single disk or slot opener no-till drill to release less carbon dioxide (CO2) and reduce oxidation of organic matter compared to wide-point hoe/chisel opener seeder drill.
- Perform soil disturbance when exposed soil carbon is less likely to be oxidized and lost as CO_2 (*e.g*. when soil temperatures are below 50° or when the soil is dry)

PLANS AND SPECIFICATIONS

In the soil carbon amendment plan, document—

- Purpose of practice
- Assessment of soil health resource concerns using state approved tools for teh appropriate land use, such as:
  - In-Field Soil Health Assessment for Cropland
  - Pasture Condition Score Sheet
  - Interpreting Indicators of Rangeland Health reference sheet
- Risk to surface and groundwater and required mitigation using Idaho Nutrient Transport Risk Assessment (INTRA)
- Laboratory soil health tests that include at least soil carbon before application
- Planned fields receiving amendments and their planned rotations, aerial photos (including location of sensitive areas), and setbacks
- Soil maps, including soil type, slope, drainage class
- Amendment analysis
- Application rate, method, timing, and method of incorporation (when applicable)
- Evaluation of carbon input effectiveness for the purpose(s) of using the In-field Soil Health Assessment Worksheet and other land use specific assessment toolsto interpret positive trends.

OPERATION AND MAINTENANCE

Monitor fields following LGU guidance and State law. Take a follow-up soil test that includes soil organic carbon at least a year after application to determine the effectiveness of the application for improving soil organic carbon. Consider testing at least 3 years after application to evaluate the impact of the amendment on other soil health-related resource concerns.

Inspect and evaluate surface applied applications after the first heavy precipitation event to assure that the material is stable and does not impact non-target areas.

Calibrate application equipment to ensure accurate distribution of material at planned rates.

Evaluate the effectiveness of the amendment (application, amount of cover provided, durability, etc.) and adjust future management or type of amendment to better meet the intended purpose(s).

REFERENCES

Practical References for Composting and Compost Sampling

For folks that want to obtain samples and send into labs:
https://www.extension.uidaho.edu/publishing/pdf/CIS/CIS1139.pdf

https://www.extension.uidaho.edu/publishing/pdf/PNW/PNW673.pdf

Or folks that want information on composting their own materials:

https://www.extension.uidaho.edu/publishing/pdf/CIS/CIS1179.pdf

https://www.extension.uidaho.edu/publishing/pdf/CIS/CIS1190.pdf

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US Biochar Initiative. Biochar Information. https://biochar-us.org/biochar-basics

US Composting Council. Labs Certified STA for Compost. https://www.compostingcouncil.org/page/CertifiedLabs

USDA, NRCS. 2007. Nutrient Management Technical Note 7, Reducing Risk of E. coli O157:H7. https://go.usa.gov/xVdD6

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