USDA Natural Resources Conservation Service
U.S. DEPARTMENT OF AGRICULTURE

Planning CPS 336 - Soil Carbon Amendment

Frequently Asked Questions

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Contents

Helping a Producer Find and Select Biochar

How do I know if biochar and/or biochar plus compost is right for a producer?

The standard lists the following purposes for the application of CPS 336: improve or maintain soil organic matter, sequester carbon and enhance soil carbon (C) stocks, improve soil aggregate stability, and improve habitat for soil organisms. In addition, producers may indicate other goals, such as improved naturally available soil moisture and increased plant productivity.

The degree of improvement of a soil depends on the initial condition of the soil. Less healthy soils are more likely to improve than healthy soils. Sandy, acidic soils are more likely to see a benefit from biochar application. For assistance on identifying soils suitable for biochar and/or compost, see the section on "Using Web Soil Survey's Dynamic Soil Properties Response to Biochar Layer"

Why would a producer choose biochar, compost, or a combination of the two?

One of the biggest advantages of biochar versus compost is that biochar provides a much higher amount of stable carbon to increase and maintain soil organic matter (SOM) over time. After 1 year, the increase in amount of carbon in the soil for 10 cubic yards of biochar equaled that for 40 cubic yards of compost. In addition, biochar can last hundreds to thousands of years while compost degrades faster than biochar. According to research, roughly 60-80% of the carbon in biochar remains in the soil after 100 years compared to 2-14% of the carbon in compost. Biochar can help neutralize acidic soil and create a home for beneficial microbes. Plant responses to biochar amendments are often not certain compared with synthetic inputs or compost used to enhance soil conditions to crop production in the short-term. Nevertheless, the long-term benefit of biochar contributing to a verity of soil health improvements outweighs the short nutrient benefits. Fresh biochar of various forms is a stable organic material that takes a long time to decay thus has a chance to reduce crop yields by binding and immobilizing nutrients and depriving plant growth. Whereas highly microbial compost, if not mature enough, may introduce pathogens. Compost is the aerobic microbial decomposition and stabilization of organic matter and has more labile carbon and a more active microbial community. A producer may prefer compost, which provides short-term benefits such as nutrient supply, enhancement of soil biological activities, and easily produce a sustainable way to recycle organic nutrients. Many producers may prefer the combination of biochar and compost to get the benefits of both, where biochar improves soil structure and retains nutrients, compost supplies immediate nutrients and beneficial microbes. A combination of biochar and compost application is likely to have several benefits for soil health such as nutrient use efficiency, nutrient flow management, soil biological activities, water holding capacity, etc. would be greater than the individual application of biochar or compost.

General Comparison of Biochar and Compost

FEATURE	BIOCHAR	COMPOST
Primary Function	Soil structure and long-term carbon storage	Immediate nutrient supply and microbial inoculation
Nutrient Content	Low; primariliy acts as a "sponge" to hold nutrients	high; contains macro and micronutrients
Microbial Life	Initially steril; provides a porous habitat for microbes	Rich in active microorganisms that cycle nutrients
Carbon Impact	Long-term carbon sequestration	Short-term carbon cycling
Lifespan	Decades to centuries (highly stable)	1-6 years; decomposes rapidly
Production	Pyrolysis (high heat with limited oxygen)	Aerobic decomposition (microbial breakdown of organic waste)

Where can farmers purchase biochar?

NRCS does not endorse or recommend a product. However, States can maintain a list of biochar retailers as long as the list is not selective, anyone can be easily added to the list, and staff do not recommend any one product or company over another. The **U.S. Biochar Initiative** (USBI) maintains a **directory of biochar producers** however, the list may not include all available producers. Northeastern States have shared a list of soil carbon amendments on the **Northeast Soil Health Teams channel**. The **Pacific Northwest Biochar Atlas** has a **directory for retailers** in the western part of the United States.

Can NRCS pay for biochar or compost being made from biosolids (human waste) under CPS 336?

No. Biochar and compost made from biosolids/ municipal waste may contain per- and polyfluoroalkyl substances (PFAS) and other chemicals that could pose health risks. Per EPA, the science around PFAS is still considered "emerging" and PFAS methodologies for soils are being determined. For support on PFAS, please reach out to a member of the USDA-PFAS Coordination Team, led by Deputy Chief for Science and Technology.

Can biochar be certified organic?

Biochar may be able to be certified organic if it follows Organic materials Review Institute (OMRI) rules.

Is biochar made from raw (uncomposted) animal manure feedstocks allowed under CPS 336?

The fresh manure must first be dried to reduce moisture content by sun drying or mechanical heating prior to pyrolysis.

Is biochar or compost made from digestate allowed under CPS 336?

Yes, as long as it doesn't contain biosolid waste.

Is biochar or compost made from food waste allowed under CPS 336?

Yes, as long as it is an industrial food waste. For instance, any remaining component of a plant/ crop (e.g., corn hulls, potato peelings) not used in food production.

Biocharred wood, NRCS Oregon

Soil and Soil Carbon Amendment Testing

Does CPS 336 pay for biochar and/or compost testing?

Yes. However, the practice standard states that the producer of the amendment is responsible for providing the feedstock characteristics report to the recipient.

Where can biochar be tested?

Please visit the U.S. Biochar Initiative (USBI) website for a list of available laboratories that offer testing.

How do I test "other carbon amendment"?

Use any laboratory that provides testing.

What is the best way to test a compost/biochar mix?

Test each amendment separately. For help on determining the characteristics of the applied amendment, use the Carbon Amendment Calculator found on eDirectives (**https://directives.sc.egov.usda.gov/landingpage/2a9d46cd-1a43-4ef8-9caa-61dea6307568**).

Who is responsible for testing biochar, the contract holder (i.e. farmer) or biochar seller?

Ultimately, it is the responsibility of the applicant to provide test results for products they are using under 336. However, most biochar sellers can produce a biochar spec sheet for their product.

Does each batch of biochar need to be tested?

It is recommended that each batch of compost or biochar is tested. However, if pyrolysis temperature and feedstock do not change, a spec sheet that is 2 years old or less is probably sufficient.

A producer wants to use biochar that is "IBI Certified" and has submitted the certificate. Is that all I need?

No. You still need to see the spec sheet to determine if the biochar product meets NRCS standards and is appropriate for the soils it will be applied to.

Some biochar producers are claiming that their biochar is "USDA BioPreferred." What does that mean?

The BioPreferred Program is a USDA-led initiative that aims to assist in the development and expansion of markets for biobased products. Products need to meet a minimum biobased content set by USDA. The manufacturers of these products must test the biobased content at an independent, third-party laboratory. "USDA BioPreferred" products MAY OR MAY NOT meet NRCS standards for cost reimbursement under CPS 336, and each product must be checked individually to ensure it meets the standard.

I am encountering issues with labs not reporting all values listed in Table 1 of the CPS 336. Do I need to focus on the labs that have the most complete ranges as much as those that just give "report"? The standard says to "Report all parameters."

Everything within the tables is required. Please contact the laboratory prior to requesting the parameters outlined in the table to ensure that the requirements of the practice standard can be met.

If a producer is using an amendment produced on site, do they still have to provide the analysis?

Yes.

Why is "Production Temperature" required in the calculator but not listed as a requirement in Tables 1 and 3 in CPS 336?

The practice standard reads, "Use biochar that is produced by heating biomass to a temperature in excess of 350 °C under conditions of controlled and limited oxygen concentrations to prevent combustion (i.e., pyrolysis or gasification)."

Carbon test, NRCS Oklahoma

Resource Concerns

How do I determine if there exists a resource concern eligible for CPS 336?

Each State is responsible for defining how a resource concern is identified. Some States use the following: In-field Soil Health Assessment (IFSHA), Pasture Condition Score Sheet, soil test results and SOM percentage thresholds (a resource concern exists in the soils; percentage is less than the pre-colonial area levels), NRCS wind or water erosion technology, and client/planner observation.

Can a producer with great soil health in their operation request CPS 336 if their only purpose is to sequester carbon?

Yes. In this case, biochar or biochar plus compost can be planned.

Can you better explain the restrictions of "residues" used for biochar?

Anything that would normally stay on the land (i.e. corn stalks or coarse woody debris), cannot be removed and used as biochar, compost or other soil amendment and paid under CPS 336.

Could someone select "Other Carbon Amendment" if the product does not meet the definition of biochar or compost (e.g., pyrolysis temperature not met, product not fully broken down, etc.)?

Yes. It still must meet the characteristics outlined in Table 1 of the practice standard.

Other Carbon Amendment Calculations		
Parameter	Units	Value
Moisture	% Moisture	0.0
Volume to Weight	yd3/dry ton	0.0
	yd3/wet ton	0.0

Parameter	lbs/wet ton	lbs/yd3
Boron	0.00	0.00
CaCO3e (lime)	0.0	0.00
Calcium	0.0	0.00
Corg	0.0	0.00
Copper	0.00	0.00
C:N Ratio*	0.0	0.00
Iron	0.00	0.00
Magnesium	0.00	0.00
Manganese	0.00	0.00
Molybdenum	0.00	0.00
Nitrogen, Total	0.0	0.00
Phosphorus	0.00	0.00
Potassium	0.00	0.00
Sulfur	0.00	0.00
Zinc	0.00	0.00

*C:N ratio based on Corg and total nitrogen

Biochar Calculations		
Parameter	Units	Value
Moisture	% Moisture	0.0
Volume to Weight	yd3/dry ton	0.0
	yd3/wet ton	0.0

Parameter	lbs/wet ton	lbs/yd3
Boron	0.00	0.00
CaCO3e (lime)	0.0	0.00
Calcium	0.0	0.00
Corg	0.0	0.00
Copper	0.00	0.00
C:N Ratio*	0.0	0.00
Iron	0.00	0.00
Magnesium	0.00	0.00
Manganese	0.00	0.00
Molybdenum	0.00	0.00
Nitrogen, Total	0.0	0.00
Phosphorus	0.00	0.00
Potassium	0.00	0.00
Sulfur	0.00	0.00
Volatile Matter	0.00	0.00
Zinc	0.00	0.00

*C:N ratio based on volatile matter and total nitrogen

Compost Calculations		
Parameter	Units	Value
Moisture	% Moisture	0.0
Volume to Weight	yd3/dry ton	0.00
	yd3/wet ton	0.00

Parameter	lbs/wet ton	lbs/yd3
Boron	0.00	0.00
Calcium	0.0	0.00
Corg	0.0	0.00
Copper	0.00	0.00
C:N Ratio	0.00	0.00
Iron	0.00	0.00
Magnesium	0.0	0.00
Manganese	0.00	0.00
Molybdenum	0.00	0.00
Nitrogen, Total	0.0	0.00
Organic Matter	0.0	0.00
Phosphorus	0.00	0.00
Potassium	0.0	0.00
Sulfur	0.00	0.00
Zinc	0.00	0.00

*C:N ratio based on Corg and total nitrogen

Soil Fertility Calculations	
	Other
yd3/acre Applied	0
Wet tons applied	0.0
% Acre Treated	100

Nutrients Applied	lbs/treated acre
Boron	0.00
CaCO3e (lime)	0.00
Calcium	0.00
Corg	0.00
Copper	0.00
C:N Ratio	0.00
Iron	0.00
Magnesium	0.00
Manganese	0.00
Molybdenum	0.00
Nitrogen, Total	0.00
Organic Matter	0.00
Phosphorus	0.00
Potassium	0.00
Sulfur	0.00
Volatile Matter	0.00
Zinc	0.00

Soil Carbon Amendment Calculator

Where can I find the CPS 336 Carbon Amendment Calculator?

The calculator and instructions are located on eDirectives (**https://directives.sc.egov.usda.gov/landingpage/2a9d46cd-1a43-4ef8-9caa-61dea6307568**).

What does the soil carbon amendment calculator tell me?

The calculator determines if the feedstock meets the criteria outlined in CPS 336. When the application rate is entered, the calculator provides the quantities of macro- and micronutrients and organic carbon applied. The biochar calculator provides several pieces of information to aid in the planning of 336 projects.

Tab 1 Instructions: The instructions provide helpful, step-by-step guidance to filling out the calculator.

Tab 2 Input: Fill in the values from the spec sheet for the soil carbon amendment you are planning – other carbon amendment, biochar, and/or compost. The data on this tab auto populates the data on the "Output" tab. Once the data is put into the spreadsheet, it will easily tell you if the product meets specifications identified in the standard.

Tab 3 Output: The third tab is auto populated from the input tab and will calculate the nutrient contributions of the soil carbon amendment, including how much fertilizer and/or lime can be reduced with the addition of the soil carbon amendment. It will also give an approximate value of how much the SOM will increase in the soil it is being applied to.

Tab 4 Report: Tab four is a printable, 1-page report of the results.

Does the biochar calculator tell me how many cubic yards of biochar can safely be applied to soils?

Not necessarily. Once you enter information from the biochar spec sheet into the calculator, you will see if the product meets NRCS specifications according to the standard (first tab). However, this calculator does not give you recommended rates and recipes for biochar.

The calculator tells me how much C amendment to apply to increase SOM by a certain percentage. Should I just follow that?

While it may be interesting to know how much adding a C amendment will raise SOM, do not use this to calculate rates. Adding large amounts is very costly and may potentially have a neutral or negative effect on soils.

What if a nutrient or heavy metal is labelled ND (non-detectable)?

If an element is ND, enter a zero into the calculator.

What if the C amendment is being surface applied? What depth should I specify?

For the calculation to work, an incorporation depth must be specified even if the soil carbon amendment will be applied on the surface. Entering in a value of 0.1 is sufficient.

When I insert the value of the C amendment in the calculator, the "Meets 336 Standard" cell still says "Not Required." Should it be red (does not meet) or green (meets)?

Make sure you select "yes" at the top to indicate which soil carbon amendment is being used.

Key
Input (required)
Input (**default value** , may be adjusted)
Output

Potential Fertilizer Offset

Intended Crop:			
Nutrient	Fertilizer Recomendation (from Soil Test) (lb/Acre)	Predicted Contribution from amendment blend (lb/ treated acre)	Percent Offset
Boron		0.0	Not Applicable
Lime		0.0	Not Applicable
Calcium		0.0	Not Applicable
Corg		0.0	Not Applicable
Copper		0.0	Not Applicable
Iron		0.0	Not Applicable
Magnesium		0.0	Not Applicable
Manganese		0.0	Not Applicable
Molybdenum		0.0	Not Applicable
Nitrogen, Total		0.0	Not Applicable
Phosphorus (P2O5)		0.0	Not Applicable
Potassium (K2O)		0.0	Not Applicable
Sulfur		0.0	Not Applicable
Zinc		0.0	Not Applicable

Screenshot of part of the calculator, which is in Excel

Choosing the Right Biochar Feedstock and Planning Appropriate Application Rates (aka "Rates and Recipes")

There are many different types of feedstocks for biochar. How do I help farmers determine which is best for them?

In most cases, the feedstock will be determined by location. For example, in heavily wooded parts of the country, biochar will most likely be made from wood chips. In areas with high concentrations of confined animal feeding operations, biochar might be made from treated animal waste.

Does biochar raise the soil pH? How can I determine how much?

Because it is usually alkaline in nature, biochar is most effective as a liming agent to raise the pH of acidic soils. In alkaline soils, it may act more as a buffer, helping to prevent further rapid shifts, though it can sometimes increase alkalinity even further depending on its own pH level.

How much biochar raises pH depends on the liming equivalency. If a soil test calls for lime and the farmer is also going to apply biochar, the amount of lime required may be less than what the soil test recommends. For example, if a soil test reveals that 1 ton of lime is needed per acre to raise the pH to optimal levels and the producer will apply 1 ton/acre of biochar with a liming equivalency of 9% CaCO3, the lime required would be reduced by 9% (the farmer would only need to apply 0.91 ton of lime).

If the native soil already has a pH above 7, use biochar with caution, check the liming equivalency, and add slowly.

Higher amendment rates can lead to greater pH change. Typically, soils with higher clay content have a higher buffering capacity so pH may be less affected by a biochar application. Biochar particle size also plays a role: biochar with smaller particle size will have a larger surface area available to interact with and neutralize acid or base ions in soil. If you are using biochar as a liming alternative, the amendment does not meet the purpose of CPS 336.

Does biochar raise the amount of salts in the soil and how can I tell if it will be harmful?

Yes. Biochar can intensify soil salinization, especially when applied in high quantities. Biochar may help to reduce salinity in salt-affected soils depending on the source of the biochar. The effect of biochar depends on the characteristics of the selected biochar, soil properties (salinity), and the presence of leaching. For example, if the intended biochar has high electrical conductivity (EC) compared to the soil and the irrigation water has high EC (saline), the soil salinity is likely to increase. On the other hand, benefits of biochar, such as improved soil structure and increased sorptive properties, and biochar's high surface can reduce salinity. Improved soil structure allows for better infiltration which can help "flush" salts out of the root zone. In addition, because biochar has a negative soil surface, sodium (Na+) is easily sorbed, which reduces the availability of sodium to plants.

Can humic and fulvic substances be approved as a carbon amendment for CPS 336?

No. Humic and fulvic substances, while derived from humates, are mined minerals. They can be considered as inoculants for biochar and compost and thus improve nutrient availability.

A producer wants to use a wood-based biochar that has high carbon content (above 85%). It has not been inoculated with nutrients but there is a small amount of P in it. The soils being amended have high P content because manure has been historically applied. Does that mean the producer should not apply biochar?

Not necessarily. All biochar will have some phosphorus (P) in them, but it won't necessarily be labile P. If it is a wood-based biochar without nutrients added, application of biochar may sorb P (and other nutrients). Please see CPS 336 Carbon Amendment Calculator.

What can be inoculated or charged with biochar?

Biochar can be "charged" with nutrients like compost tea and liquid fertilizer or "inoculated" by additions of microbes like those found in compost. Since biochar has a negative charge with a high surface area, charging provides nutrients for plant uptake while inoculating provides beneficial microorganisms to support nutrient availability. Please note, the charging and inoculation of biochar is not in the criteria of CPS 336 unless biochar and compost are mixed.

What is the application rate for amending soils with biochar?

Recommended application rates for any soil amendment should be based on soil testing and the testing of the selected carbon amendment. Since biochar differs widely in its characteristics, the nature of the material also influences the rate of application. In general, 4 to 10 cubic yards per acre is a good place to start. Understanding that the characteristics of the soil and amendment will be key in determining the application rate.

Can biochar be mixed with raw manure and then applied?

Yes. NRCS does recommend manure as an inoculant as stated in the General Considerations Section of CPS 336, but the standard does not pay for it. The planner would contract the 100% biochar scenario, and the applicant would mix with manure at their own expense in accordance with a nutrient management plan. The planner would certify the practice only after the soil carbon amendment was applied to the field. Only the biochar would be considered toward meeting any states minimum quantity to be applied. Example would be if a state decided 4 cubic yard minimum application to meet CPS 336, then this is how much biochar must be applied. The manure would then be in addition to that at their own expense.

Planning and Contracting CPS 336

What is the lifespan of CPS 336 and how many times can it be planned in a contract?

It is 1 year and can be contracted up to 5 times over the life of a contract.

I'm finding the 336 applications are ranking too low to fund, even though they are great projects. Why is that?

CPS 336 applications would rank low if the only practices planned are 336. Soil carbon amendment works best in a suite of soil health practices. Planning other practices on the CSAF list such as 328 Conservation Crop Rotation, 329 Residue and Tillage Management, No-Till, 340 Cover Crops, 484 Mulch, 612 Tree and Shrub Planting, etc. along with CPS 336 will increase its ranking.

Can CPS 336 be applied to pasture and/or rangeland?

CPS 336 can be planned on pasture but not native rangeland except where it is facilitating CPS Range Planting (550) or CPS Critical Area Planting (342).

Which scenario unit should I chose – acres, cubic yards or square feet?

The acres unit of CPS 336 assumes that 4 cubic yards of biochar will be applied per acre. Some states have opted to add cubic yard scenarios, and these can be contracted when there is more or less than 4 cubic yards per acre being planned. The "small areas" scenario has a unit measurement of square feet versus acres.

This scenario should be used when hand tools such as wheelbarrows are being used to spread the material. For compost, the acre unit assumes an application rate of 3 tons per acre. For other scenarios, it is slightly different.

Table 1: FY2024 336 Scenarios

NO.	NAME	SCENARIO UNIT	QUANTITY COMPOST	QUANTITY BIOCHAR
28	Compost - On Site	Acres	Not Specified	
29	Compost - Off Site	Acres	3 tons per acre	
30	100% Biochar	Acres		4 cubic yards per acre
31	Other Carbon Amendment	Acres	Not Specified	
32	Compost Small Areas	1,000 square feet	1 ton	
33	Compost + Biochar - Small Areas	1,000 square feet	.5 tons	.38 cubic yards
34	40% Biochar - 60% Compost	Acres	3.3 tons	1.6 cubic yards
35	20% Biochar - 80% Compost	Acres	4.4 tons	.8 cubic yards
36	60% Biochar - 40% Compost	Acres	2.2 tons	2.4 cubic yards
37	80% Biochar - 20% Compost	Acres	1.1 tons	3.2 cubic yards
105	100% Biochar - Cubic Yards	Cubic Yards		4 cubic yards per acre
106	Compost + Biochar - Small Areas Cubic Yards	Cubic Yards	2 tons	1.5 cubic yards
125	Compost - Small Areas Cubic Yards	Cubic Yards	3 tons	
126	Compost - Off Site Cubic Yards	Cubic Yards	3 tons	

The FY2025 payment rate for "Compost On-Site" is higher than "Compost Off-Site". Why is this?

Both payment scenarios include compost testing as part of the components. A producer making their own compost must pay for their own testing and so meeting the standard will be more costly.

Can CPS 336 be contracted with CPS 590 (Nutrient Management)?

Yes.

Is it required that CPS 590 be planned with CPS 336?

CPS 590 is only required to be contracted in conjunction with CPS 336 if a Conservation Nutrient Management Plan is required per policy. To address potential resource concerns from overapplying nutrients, you may apply statewide tools instead. For example, in the Northeast, the over-application of phosphorous is a concern on cropland and pastures that have seen high applications of manure. The P index is looked at to ensure that a SCA rich in P is not applied to soils that are in the high or very high category.

Table 2:
Overall interpretation and management implication of the NE-PI 2.0

Overall interpretation (transport score x BMP score x 10)

Management implication for NY, CT, MA, ME, and RI

Soil test P (Morgan or Modified Morgan in lbs/acre)

P-LOSS RISK	PI SCORE
Low	< 50
Medium	50-74
High	75-99
Very High	≥ 100

< 40	40-100	101-160	> 160
N-based	N-based	P-based +20	Zero P +20
N-based	P-based +20	Zero P +20	Zero P +20
P-based	P-based	Zero P	Zero P
Zero P	Zero P	Zero P	Zero P

When should CPS 484 (Mulching) be used instead of CPS 336 since the purpose of both is to increase carbon in soils?

If wood chip material is applied to the soil surface, use CPS 484.

How is biochar incorporated into the soil?

Biochar can be incorporated into the soil the same ways soil amendments are normally incorporated. This includes tillage, trenching, no-till drill, added when creating permanent beds, surface applied, or mixed into water. For best results, incorporate biochar into the soil.

What is an example of the equipment used to inject the biochar? Are there issues with plugging up the equipment?

Equipment used will depend on the size of the biochar. Biochar can be crushed and screened into small, uniform sizes or compressed into prills. Application may include no-till drills, trenching, fertigation, and injection of a biochar-manure combination. Biochar could plug equipment if it is not sized appropriately.

Doesn't the deep tillage counteract the benefit of biochar? What is the carbon neutral payoff time?

Amending soil with biochar using deep tillage is a one-time disturbance. While deep tillage does release some carbon into the atmosphere, biochar is a very stable form of carbon. Fifty to 80% of biochar remains in the soil (depending on the hydrogen to organic carbon ratio, H:Corg) after 100 years.

Is a specific time of year best for biochar application?

Biochar can be applied any time the ground is not frozen, ideally when the soil conditions are optimal. The most common time for biochar application is in early spring, at the beginning of the growing season (when microbes are active). Application of biochar after a harvest, with a cover crop, allows biochar to equilibrate with the system while also minimizing loss of the amendment to water and wind erosion and loss of nutrients. For efficiency, consider biochar applications mixed with other organic amendments (compost, manure) and/or during a management operation (e.g., tillage).

Can biochar made from crowns and tops of trees or corn stover be applied?

You cannot use biochar produced from crop residues that could otherwise provide soil protection or from woody residue that is necessary to sustain forest health.

Are overland flow issues of concern if biochar is surface-applied on slopes?

Yes, it absolutely can be a concern. Any carbon amendment, especially biochar, is susceptible to wind and water erosion. The standard says, "Do not apply where soil, site, climate, or condition pose a significant risk of loss due to slope, runoff potential, rainfall or irrigation intensity, or other factors." Besides tillage, biochar can be incorporated into the soil in several different ways. These include no-till drill (i.e. biochar pellets), injected into the ground (i.e. mixed with manure and passed through manure injection systems), through irrigation lines (i.e. super fine biochar that is suspended in water), passed through no-till coulters, manure spreaders, and zone tillage (this could also include putting biochar into holes when planting perennial crops such as apple trees).

Can biochar be applied and incorporated into highly erodible land (HEL) fields?

Yes, as long as the producer is following their HEL conservation plan and adhering to Food Security Act rules.

How much does a cubic yard of biochar weigh?

The dry weight of a cubic yard of biochar ranges from approximately 135 to 540 lbs. Because biochar readily absorbs moisture from the air, how biochar is stored (protected from moisture or not) can affect its weight.

Reading a Biochar Spec Sheet

For more information on how to read a biochar spec sheet, please see this **fact sheet** developed by the U.S. Biochar Initiative.

What are the important things to look for on a biochar spec sheet?

- High organic carbon content (above 85% is ideal).
- H:Corg Ratio: This indicates how stable the carbon is. The lower the number, the more stable the carbon. The higher the number, the faster the carbon will break down. To meet NRCS standards for 336, biochar must be under 0.7.
- Low ash.
- Low EC numbers (under 8), especially when salts are a concern such as areas experiencing low natural rainfall like high tunnels. Manure based biochar will be higher in salts which is ok if it is being applied in an area where salts are not a concern.
- Low liming equivalency (unless it is hoped that the biochar will raise pH).
- Low lead (Pb) content. While the standard has a threshold of 300 ppm, biochar (and compost) should contain very little Pb (less than 10ppm), especially if it is being applied to urban or other soils where the soil Pb level is above 100 ppm.

Why is moisture content listed as %DW? Shouldn't this be wet weight?

It should be %. This value is important, especially for biochar, because application is weight based (think payment) and the product contains a significant amount of moisture.

See a spec sheet example on the next page.

Spec Sheet Example 1

International BioChar Initiative (IBI)
Laboratory Test for Certification Program

Sample ID: Pullet manure char

Lab ID Number: 3110458-01

Biochar has very low hydrogen to carbon ratio which means it is very stable and will stay in the soil for a long time.

Biochar has low liming value but will raise pH in soils if applied in large amounts.

Biochar is very high in carbon and low in ash, so it will add more carbon to soils.

Biochar is very low in salts (less than 4 dS/m).

Biochar is not a significant source of nutrients. It's suitable for soils with high P. It will need to be mixed with compost to "charge."

Biochar Sample Properties	Dry Basis Unless Stated	Range	Units	Method
Moisture (time of analysis)	31.6		% wet wt.	ASTM D1762-84 (105c)
Bulk Density	8.3		lb/cu ft	
Organic Carbon	92.7		% total dry mass	Dry Combust-ASTM D 4373
Hydrogen/Carbon (H:C)	0.18	0.7 Max	Molar Ratio	H dry combustion/C (above)
Total Ash	2.3		% total dry mass	ASTM D1762-84
Total Nitrogen	0.83		% total dry mass	Dry Combustion
pH value	9.82		units	4.11 USCC:dil. Rajkovich
Electrical Conductivity (EC 20 w/w)	0.332		dS/m	4.10 USCC:dil. Rajkovich
Liming (neut. Value as-CaCO3)	12.3		%CaCO3	AOAC 955.01
Carbonates (as-CaCO3)	4.6		%CaCO3	ASTM D 4373
Butane Act.	2.4		g/100g dry	ASTM D 5742-95
Surface Area Correlation	210		m2/g dry	G

All units mg/kg dry unless stated

Elemental Analysis	Results	Range of Max. Levels	Reporting Limit (ppm)	Method
Arsenic (As)	ND	13 to 100	0.40	J
Cadmium (Cd)	ND	1.4 to 39	0.16	J
Chromium (Cr)	87.3	93 to 1200	0.40	J
Cobalt (Co)	1.2	34 to 100	0.40	J
Copper (Cu)	4.8	143 to 6000	0.40	J
Lead (Pb)	0.2	121 to 300	0.16	J
Molybdenum (Mo)	0.4	5 to 75	0.40	J
Mercury (Hg)	ND	1 to 17	0.001	EPA 7471
Nickel (Ni)	34.3	47 to 420	0.40	J
Selenium (Se)	ND	2 to 200	0.79	J
Zinc (Zn)	6.9	416 to 7400	0.79	J
Boron (B)	34.6	Declaration	4.0	TMECC
Chlorine (Cl)	300	Declaration	20.0	TMECC
Sodium (Na)	396	Declaration	395	E
Iron (Fe)	483	Declaration	19.8	E
Manganese (Mn)	251	Declaration	0.4	J

Particle Size Distribution

Size	Results	Units	Methods
<0.5mm	1.4	percent	F
0.5 - 1.0 mm	0.2	percent	F
1-2 mm	1.5	percent	F
2-4 mm	15.5	percent	F
4-8 mm	53.4	percent	F
8-16 mm	28.0	percent	F
16-25 mm	0.0	percent	F
25-50 mm	0.0	percent	F
> 50 mm	0.0	percent	F

Basic Soil Enhancement Properties

Property	Results	Units	Methods
Total (K)	4939	mg/kg	E
Total (P)	161	mg/kg	E
Ammonia (NH4-N)	3.7	mg/kg	A
Nitirate (NO3-N)	2.3	mg/kg	A
Organic (Org-N)	8275	mg/kg	Calc.
Volatile Matter	12.6	percent dw	D

Example of a high-quality biochar made from hard wood chip feedstock pyrolyzed at high temperatures. This biochar could enhance many Northeastern soils that are acidic.

Spec Sheet Example 2

International BioChar Initiative (IBI) Laboratory Test for Certification Program

Sample ID: Pullet manure char

Lab ID Number: 3110458-01

Biochar has a higher hydrogen to carbon ratio (but still within the acceptable limit) which means more carbon will break down faster.

Biochar is very low in carbon and high in ash so it will contribute less carbon to soils.

Biochar has a high liming value and will raise pH in soils.

Biochar is very high in salts (more than 8 dS/m).

Biochar is a significant source of nutrients. It's not suitable for soils with high P.

Biochar Sample Properties	Dry Basis Unless Stated	Range	Units	Method
Moisture (time of analysis)	27.3		% wet wt.	ASTM D1762-84 (105c)
Bulk Density	34.3		lb/cu ft	
Organic Carbon	30.6		% total dry mass	Dry Combust-ASTM D 4373
Hydrogen/Carbon (H:C)	0.55	0.7 Max	Molar Ratio	H dry combustion/C (above)
Total Ash	56.6		% total dry mass	ASTM D1762-84
Total Nitrogen	2.3		% total dry mass	Dry Combustion
pH value	11.94		units	4.11 USCC:dil. Rajkovich
Electrical Conductivity (EC20 w/w)	12.16		dS/m	4.10 USCC:dil. Rajkovich
Liming (neut. Value as-CaCO3)	26.0		%CaCO3	AOAC 955.01
Carbonates (as-CaCO3)	12.6		%CaCO3	ASTM D 4373
Butane Act.	1.7		g/100g dry	ASTM D 5742-95
Surface Area Correlation	188		m2/g dry	G

All units mg/kg dry unless stated

Elemental Analysis	Results	Range of Max. Levels	Reporting Limit (ppm)	Method
Arsenic (As)	0.49	13 to 100	0.49	J
Cadmium (Cd)	0.25	1.4 to 39	0.19	J
Chromium (Cr)	3.5	93 to 1200	0.49	J
Cobalt (Co)	1.0	34 to 100	0.49	J
Copper (Cu)	158	143 to 6000	0.49	J
Lead (Pb)	0.84	121 to 300	0.19	J
Molybdenum (Mo)	15.6	5 to 75	0.49	J
Mercury (Hg)	ND	1 to 17	0.001	EPA 7471
Nickel (Ni)	12.3	47 to 420	0.49	J
Selenium (Se)	1.9	2 to 200	0.97	J
Zinc (Zn)	1123	416 to 7400	0.97	J
Boron (B)	105.3	Declaration	4.9	TMECC
Chlorine (Cl)	54313	Declaration	20.0	TMECC
Sodium (Na)	17845	Declaration	485	E
Iron (Fe)	3947	Declaration	24.3	E
Manganese (Mn)	990	Declaration	0.49	J

Particle Size Distribution

Size	Results	Units	Methods
<0.5mm	44.7	percent	F
0.5 - 1.0 mm	23.5	percent	F
1-2 mm	17.5	percent	F
2-4 mm	11.6	percent	F
4-8 mm	2.7	percent	F
8-16 mm	0.0	percent	F
16-25 mm	0.0	percent	F
25-50 mm	0.0	percent	F
> 50 mm	0.0	percent	F

Basic Soil Enhancement Properties

Property	Results	Units	Methods
Total (Ca)	114369	mg/kg	E
Total (Mg)	17417	mg/kg	E
Total (K)	106602	mg/kg	E
Total (P)	62330	mg/kg	E
Ammonia (NH4-N)	5.8	mg/kg	A
Nitirate (NO3-N)	2.1	mg/kg	A
Organic (Org-N)	23406	mg/kg	Calc.
Volatile Matter	19.7	percent dw	D

Spec sheet for a biochar made from poultry manure. Biochar made from animal manures can be extremely high in salts and nutrients. This biochar may be appropriate for soils that are very acidic, are very low in nutrients, and receive high rainfall. It would NOT be appropriate for neutral to basic soils with high P or high salts.