



Biochar Storage, Shipping and Safety

*Tom Miles
Executive Director
US Biochar Initiative*



Biochars are Produced in Mobile, Modular, and Industrial Systems



"Ring of Fire"
Wilsonbiochar.com



Carbonator 6050
tigercat.com



ARTIchar
artichar.com



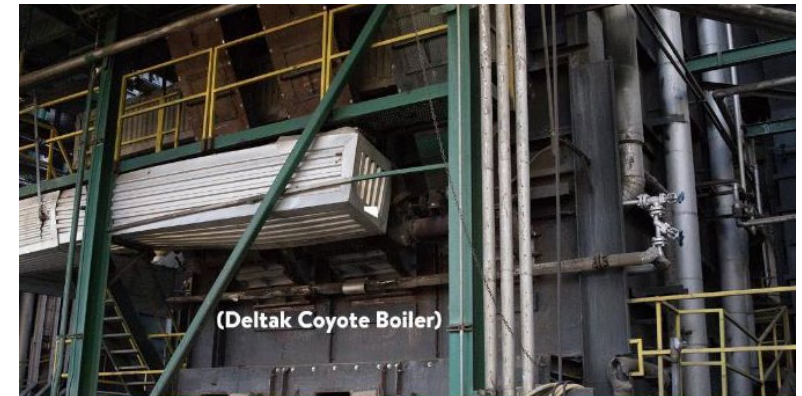
Pyreg 500
Pyreg.de



CharBoss
airburners.com



Biomacon
Biomacon.com



Oregon Biochar Solutions
Chardirect.com

Mobile Carbonizers Recover Biochar from Forest Fuels and Urban Wood: Biochar Shipped in Bag or Bulk

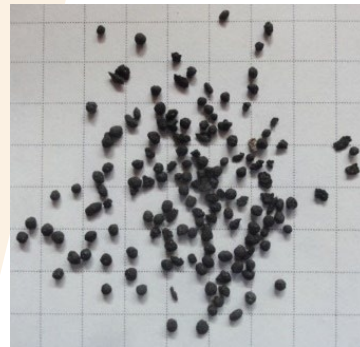


Biochar Recovered From Wildfire Debris
Oregon 2020

www.tigercat.com



Biochars are Handed in Bulk and Processed for Different Forms and Qualities for Different Uses: Size, Density, Bag, Liquify



Biochar Properties Influence Storage and Transport

Feedstock-Particle Size-Moisture-Ash

Type	Size	Range mm	Moisture %	Carbon %	Ash %	Density Lb/CY
Fine	3mm	0.5-4	6%	82%	8%	270
Fine	3mm	0.5-4	35%	82%	8%	284
Mixed Granular	4-150 mesh	0.1-5	67%	78%	14%	464
Dry Powder	<40 Mesh	.005-.03	2.5%	94%	6%	678
Power Plant Ash	40-5 mesh	0.1-4	18%	14%	78%	788
Power Plant Carbon	40-2.5 mesh	.1-8	4%	50%	25%	234

Fine



Dry Powder



Biochar Solutions LLC



Biochar Calculated Density vs Transport Weight

Scenario	Lbs per ft ³	Lb/CY	CY/ton	CY/truck	BDT/truck	Moisture Content %	Wet Tons/truck (24 Max)
A	6	162	12.3	100	8	40%	13.50
B	8	216	9.3	100	11	40%	18.00
C	10	270	7.4	100	14	40%	22.50
D	12	324	6.2	85	14	40%	22.95
E	14	378	5.3	75	14	40%	23.63
F	16	432	4.6	65	14	40%	23.40

Pacific Biochar



Biochars are Processed and Packaged for Different Uses



Agriculture, Retail Garden, Landscape, Turf, Trees, Orchards, Vineyards, Horticulture

Biochar, Compost, Composted biochar (5%-20% biochar)

Animal bedding, litter, feed trials

Biochar-Based Fertilizers (15%-25% biochar)

Biotic Soil Amendments (biochar + organics+ minerals and biologicals)

Granulated and liquid products for seeding, foliar sprays (extracts)

Micro/nano carbons, nanofertilizers



Environment, Remediation, Erosion Control

Revegetation, Biosolids, Urban Soils, Erosion Control, Wetlands, Odor, Waste, Remediation Persistent Herbicides (USCC), PFOS/PFAS



Water quality Stormwater filtration, water treatment

- functionalized chars, 3d aerogels, antibiotics



Forestry

Wildfire fuel reduction, Reforestation, Range Improvement

Growing media for nursery and out planting

Revegetation, Reclamation of mines and degraded land



Carbon, Renewable Energy Offsets, and Non-Soil Products

Carbon markets, building products, odor control, batteries



Retail Garden, Horticultural, Landscape and Fertilizer Products and Bagged and Palletized



Rexius/OpusGrows
www.opusgrows.com



Kellogg Garden Products
www.kelloggsgarden.com



15-10-10 Biochar Compound
Fertilizer

Others: Sustane Organic + Biochar, Mirimichi Green CarbonizPn Turf Enhancer, Cool Terra Engineered Biocarbon, Wakefield Biochar Soil Conditioner . . .

See: Role of biochar as an additive in organic waste composting. Miguel A. Sanchez-Monedero, Cayulela, M.L. Roig, A., Jindo, K. , Mondini, C & Bolan, N. (2018) Bioresource Technology, 247-1155-164



Biochars Complement Beneficial Supplements: Bag



American Biochar Company VITAL Blend Soil Amendment, Activated BioChar charged with freshwater-sourced Humate

ambiochar.com/products



The Andersons® Hemic DG Granular Soil Conditioner (Humic Acid) with Biochar - Hemic DG CharX

andersonshumates.com/products/#HemicDG



Liquid Biochars Are Sized, Diluted 1:5, Applied 1:20



**Biochar Slurry Fed in No Till
Cross Slot (Don Graves, NZ)**



**LET YOUR PLANTS
EAT ORGANIC.**

LESCO® CarbonPro™ delivers natural
optimizing technology to soil and plants.

**Liquid or granular biotic soil amendment for golf and turf
(LESCO CarbonPro lesco.com)**



CarbonPro-L
with MobilEX

Water Control

- Deeper stronger roots**
- Improved greening**
- Improved Soil and Seed Establishment**
- Increased Nutrient Uptake and Efficiency**
- Reduced Water Requirements**
- Targeted Benefits**



Granulated Biochar Seedballs Aid Aerial Seeding for Green Carbon Cover in Africa, Australia and America



Seedballs Kenya
seedballskenya.com



Airseed Technologies
airseedtech.com



CARBON CO-PRODUCTS: Bulk Biochars from BioPower



JOSIAH HUNT
PACIFIC BIOCHAR
CALIFORNIA



Pacificbiochar.com



USBI USDA NRCS Code 336 Soil Carbon Amendment Webinar



KARL STRAHL, VP,
OREGON BIOCHAR
SOLUTIONS



chardirect.com



Biochars are Stored and Delivered in Bulk



Storage:

- 1500 CY inventory on site
- Buildings - Dry and granular only
- Sprinklers in Storage
- Open piles 50% MC
- Hazard: Embers from other sources

2 CY 400 lb dry

- High carbon
- Low Volatiles
- Low Ash
- Low Fines
- Good Flowability

Oregon Biochar Solutions
www.chardirect.com

80 CY 8-10 t





(biochar)

BIOCHAR PRODUCED AT A NORTHERN CALIFORNIA BIOMASS POWERPLANT IS A VALUABLE INPUT FOR CREATING COMPOST.

AGRICULTURAL USES FOR BIOCHAR

Biochar can be used as a soil amendment to build healthy soil in a variety of applications

USBI USDA NRC5 Code 3.16 Soil Carbon Amendment Webinar



LEARN MORE AT www.biochar-us.org



Adding biochar can enhance the composting process:

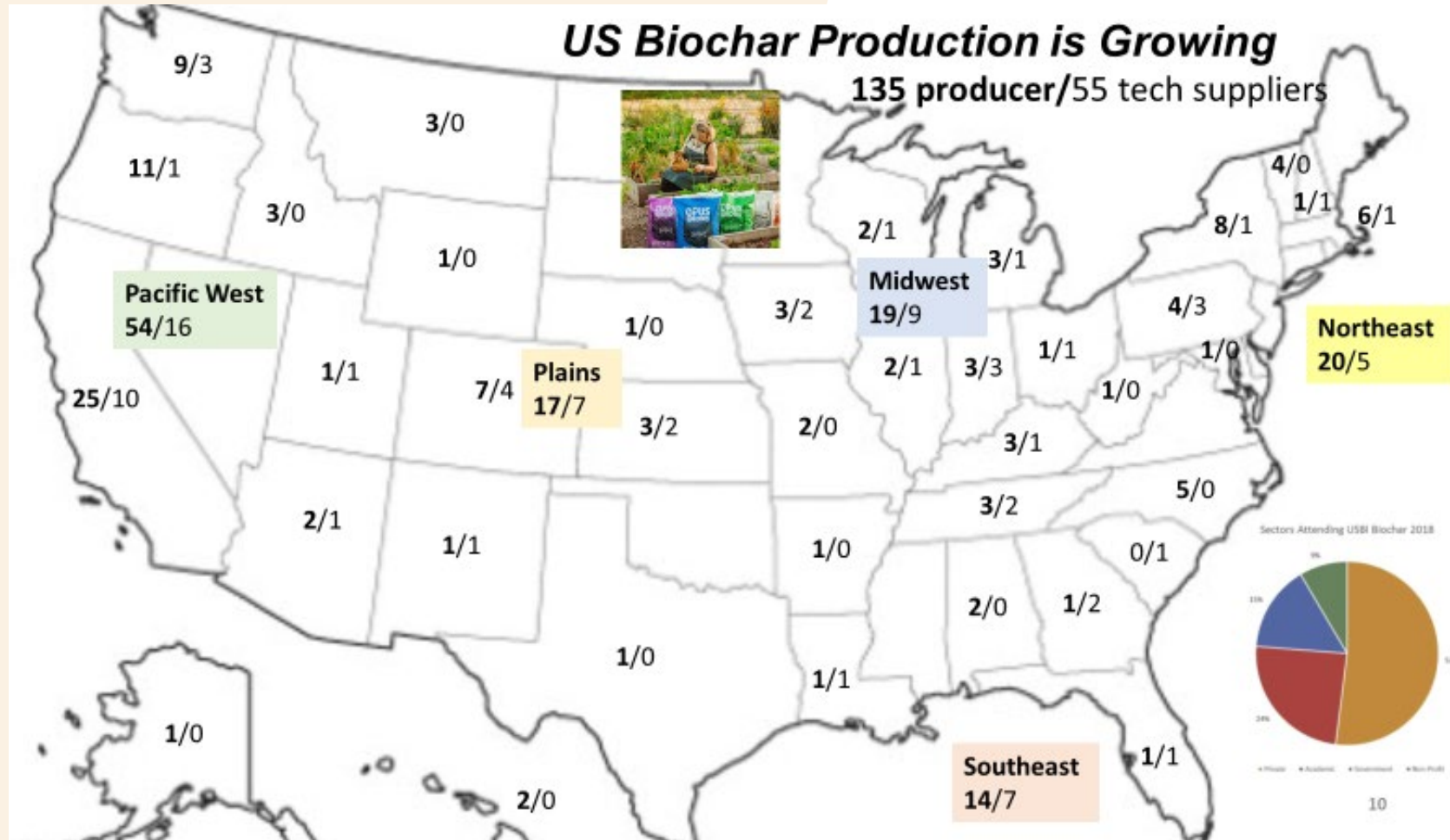
- Reduces odor
- Reduces ammonia loss
- Increases nitrogen retention
- Accelerates the composting process
- **Greatly enhances the beneficial biological populations in compost !**



char-grow.com



Biochar Shipping: Truck/Trailer, Bag/Bulk, Train



Biochars are Delivered in Bulk Bags



Bulk bag - spout top and bottom



A step deck flatbed truck loaded with 19 pallet of 4 yards – 76 cubic yards of biochar on board. *Biochar Solutions LTD.*

Transportation

- ✓ Max Truck 104 CY in bags, 10-14 tons bulk
- ✓ Biochars 400 lb/CY limited by volume not weight
- ✓ Target 1500-2200 lbs/pallet
- ✓ Average van 24-26 pallets. Double stack 48-52 bags/truck

Item	Lbs.	Tons (2000 lbs short ton)	Cubic Yards
Max truck Load Weight	80,000	40	
Truck w/o load	36,000	18	
Pallet Weight	1300	0.65	
Char weight possible	42,700	21.35	
Volume possible			
Density for max packed load	410.6		104

Biochar Solutions, LLC



Biochar Safety – Dust and Explosion

- **Moisture**

- Dry <5% MC
- Medium 15%-20% dry to touch, can be unstable
- Wet 30%-40% MC safe handling and storage, can be dry to touch

- Bulk shipping is often 30%-40% MC for Safety

- **Safety in Storage and Transportation**

- Hold 4 days in dry storage to ensure no spontaneous combustion
- Monitor temperatures of stored material
- Provide adequate water, don't let open piles dry out
- Blend with other materials
- Nitrogen blanket in conveyors and bins

4.2 Hazardous Solids -Spontaneously Combustible Materials, Pyrophoric and Self heating

- **UN Manual of Tests and Criteria**
 - 1 meter drop test with no combustion
 - Self heating test 140°C 24 hr no increase in temperature by 60°C
- **ASTM E 1226 Go-No-Go Explosive Screening**
- **ASTM E 1226 Explosive Severity (Kst, Pmax [dP/dt] max**
- **Dust Collection: NFPA 69**



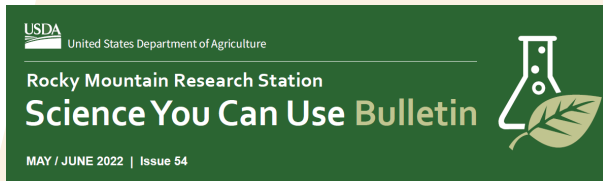
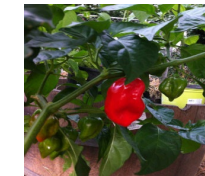
Factsheet: Biochar in Compost



Networking – Education – Demonstration Market and Technical Support



**2009- 2022 North America
Conferences, Workshops, Demos
Newsletter, Website, Directory
Social Media, Biochar@groups.io**



Biochar Basics: An A-to-Z Guide to Biochar Production, Use, and Benefits

A Little Background

When considering the amount of organic matter in soil, there is too much in some places and not enough in others. Many forests have too much organic matter to burn, and some of the carbon is stored in the soil.



USFS Biochar Basics bit.ly/3Nctv78

**www.biochar-us.org
USBiochar@gmail.com**

**www.pnwbiochar.org
Pacific Northwest Biochar Atlas
USDA ARS, NRCS**



Just Add Biochar!



Thank you!

US Biochar Initiative

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www.biochar-us.org