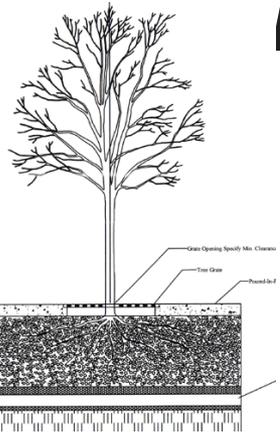




Emerging Biochar Markets



Tom Miles
T.R. Miles Technical Consultants, Inc.
North West Biochar Working Group
www.nwbiochar.org

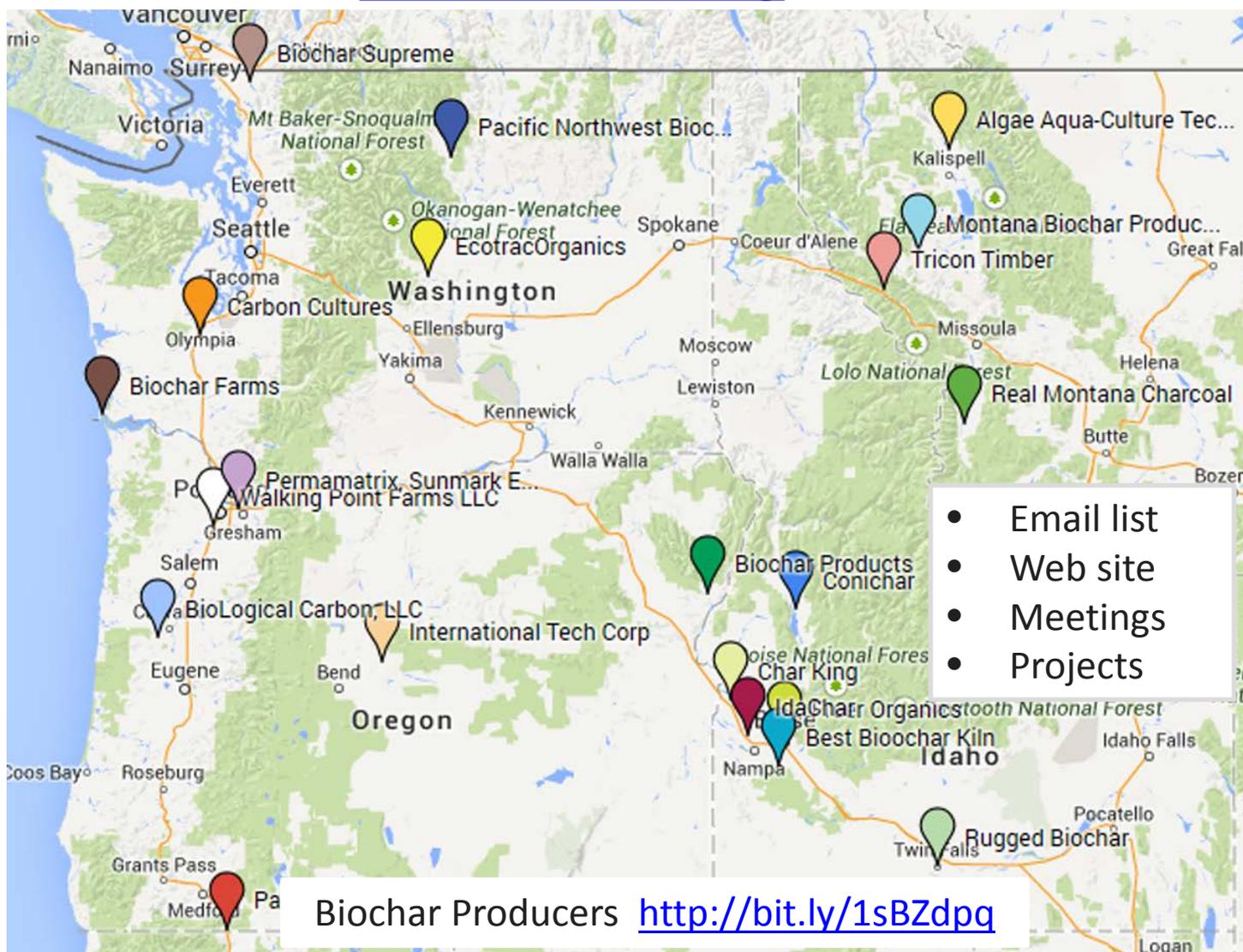


Black is the New Green
Biochar Expo
Roseburg, Oregon
October 18, 2014



NW Biochar Working Group

nwbiochar.org



Emerging Biochar Markets

- Trees and Landscaping, Structural Soil
- Nurseries
- Green roofs
- Urban Farms and Gardens
- Turf Maintenance
- Erosion Control and Soil Remediation
- Stormwater and Water Quality

Biochar for Healthy Trees



No Treatment (left) 5% biochar + compost top dressing (right)
Tree roots at 18 months in compacted soils.
Photo: Morton Arboretum Soil Science Laboratory

Trenches with Biochar + Mycorrhiza can be used to rehabilitate diseased trees, like these examples from Japan ->

(Bartlett Tree Service & Dr. Makoto Ogawa)
<http://www.bartlett.com/tips/Biochar.cfm>

Biochar + Compost
Biochar + Mycorrhiza, Composted

- Increases disease & insect resistance
- Improves microbial activity and soil fertility
- Increases soil water retention, and available water to tree roots
- Stimulates tree growth
- Improves tree survival



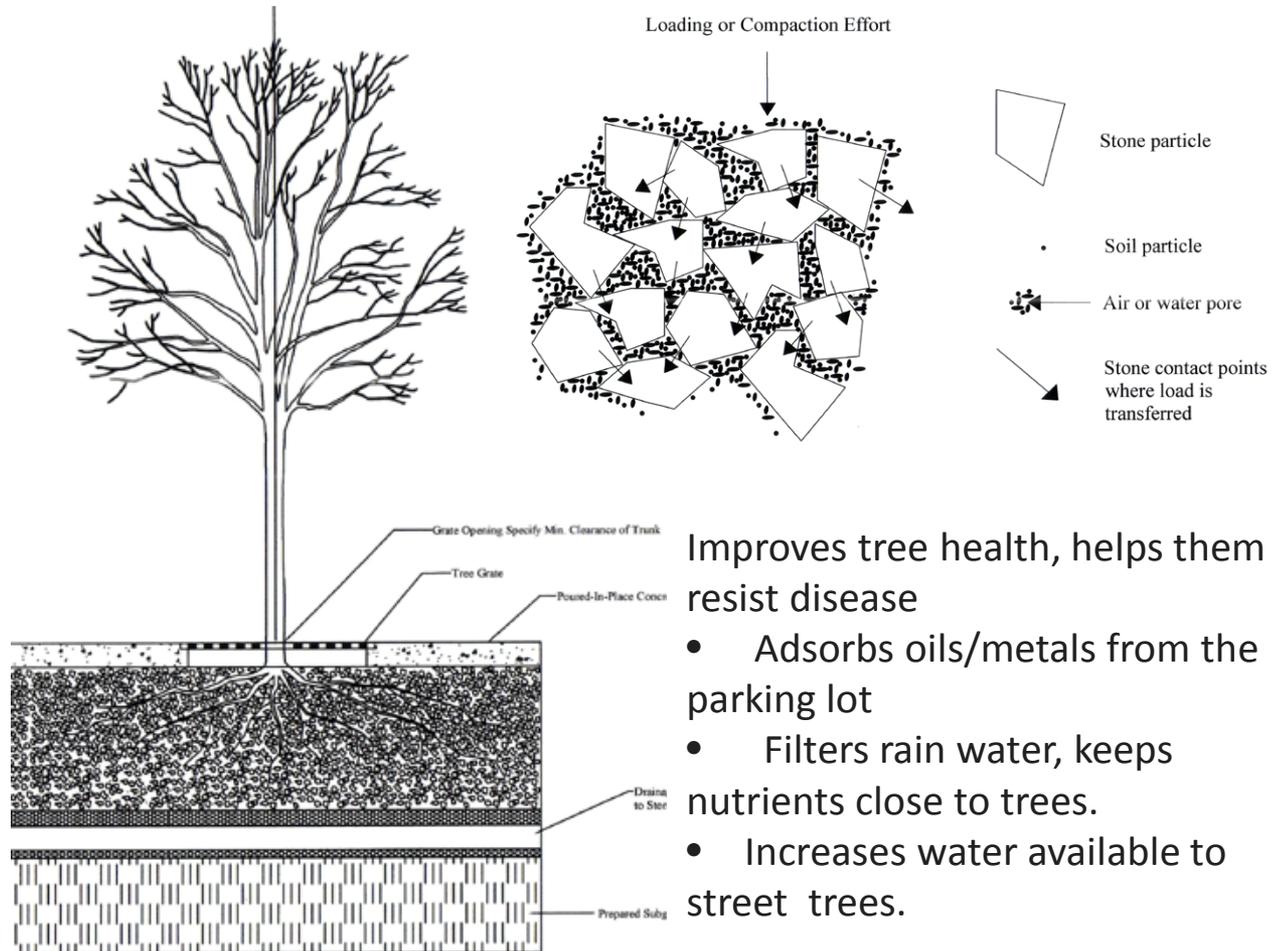
Biochar in Structural Soil

Structural Soil under Permeable Pavement for larger canopy trees in parking lots.



Parking Forest PCC
(Maria Cahill)

ParkingForest.org



Improves tree health, helps them resist disease

- Adsorbs oils/metals from the parking lot
- Filters rain water, keeps nutrients close to trees.
- Increases water available to street trees.

Structural Soil, Cornell University

www.hort.cornell.edu

Biochar in Nurseries

Agronomic Benefits

SOIL STRUCTURE-

Vermiculite substitute

COMPOST AID -

Peat substitute = Compost + Biochar

PLANT HEALTH -

Inhibits root disease

Nutrient (P) carrier for poor soils



**2008
Calforest
Nurseries**



**Ponderosa Pine in Soilless Media with
Vermiculite (Left) and Biochar (Right)**

Biochar in Green Roof Media



Using 30% biochar in scoria roof media increased plant water availability by 16% .

Cao, C.T.N., C. Farrell, P.E.
Kristiansenn, J.P. Rayner. 2014.
[Ecological Engineering 71: 368-374.](#)

Photo: Ladybird Johnson Wildflower Center

Adding 7% Biochar to Scoria based media improved the effluent with 70% reduction in Nitrates, 40% reduction in Phosphates and 70% reduction of Organics than un-amended control.

Beck, D.A., G.R. Johnson and G.A. Spolek. 2011. [Environmental Pollution 159: 2111-2118.](#)

Biochar in Urban Farms and Gardens



Ghost Peppers and
Carolina Reapers



URBAN FARMING

GREEN ANCHORS

www.facebook.com/greenanchorspdx

Carolina Reaper
1,569,000

Ghost Pepper
1,041,000



Scoville rating	Type of pepper
15,000,000–16,000,000	Pure capsaicin ^[4]
9,100,000	Nordihydrocapsaicin
2,000,000–5,300,000	Standard US Grade pepper spray ^[5]
855,000–1,041,427	Naga Jolokia ^{[6][7][8][9]}
876,000–970,000	Dorset Naga ^{[10][5]}
350,000–577,000	Red Savina Habanero ^[11]
100,000–350,000	Habanero Chile ^[12]
100,000–350,000	Scotch Bonnet ^[12]
100,000–200,000	Jamaican Hot Pepper ^[5]
50,000–100,000	Thai Pepper, Malagueta Pepper, Chiltepin Pepper
30,000–50,000	Cayenne Pepper, Aji pepper ^[12] , Tabasco pepper
10,000–23,000	Serrano Pepper
7,000–8,000	Tabasco Sauce (Habanero) ^[13]
5,000–10,000	Wax Pepper
2,500–8,000	Jalapeño Pepper
2,500–5,000	Tabasco Sauce (Tabasco pepper) ^[13]
1,500–2,500	Rocotillo Pepper
1,000–1,500	Poblano Pepper
600–800	Tabasco Sauce (Green Pepper) ^[13]
500–1000	Anaheim pepper
100–500	Pimento ^[5] , Pepperoncini
0	No heat, Bell pepper ^[5]



Biochar Can Improve Turf and Landscape Management for Parks and Recreation

- Use normal practices
- Use stable soil amendment
- Retain more water
- Replace non-sustainable materials
- Reduce chemical leaching and runoff
- Reduce chemical and fertilizer use
- Decrease saturated hydraulic conductivity
- Promote growth of microorganisms
- Sequester Carbon.

Sunmark Environmental

Sand-based turfgrass root-zone modification with biochar, Shane R. Brockhoff, Iowa State University



**Biochar + compost may resist
Pythium blight**
(Photo LP Tredway)

Biochar Helps Re-vegetation and Environmental Remediation



www.permamatrix.com

BIOCHAR IN MULCH FOR HYDROSEEDING

Biochar Improves Remediation



“This was the recycled nasty soil from the steel mill that still grew vegetation. There is a line of where we sprayed PermaMatrix and where it was not applied. The other vegetation died.”

-- Drew Schaefer Sunmark Environmental www.sunmarkenvironmental.com

Biochar in Sand and Biofilters for Industrial Stormwater Filtration

Port of Tacoma, West Hylebos Pier Log Yard

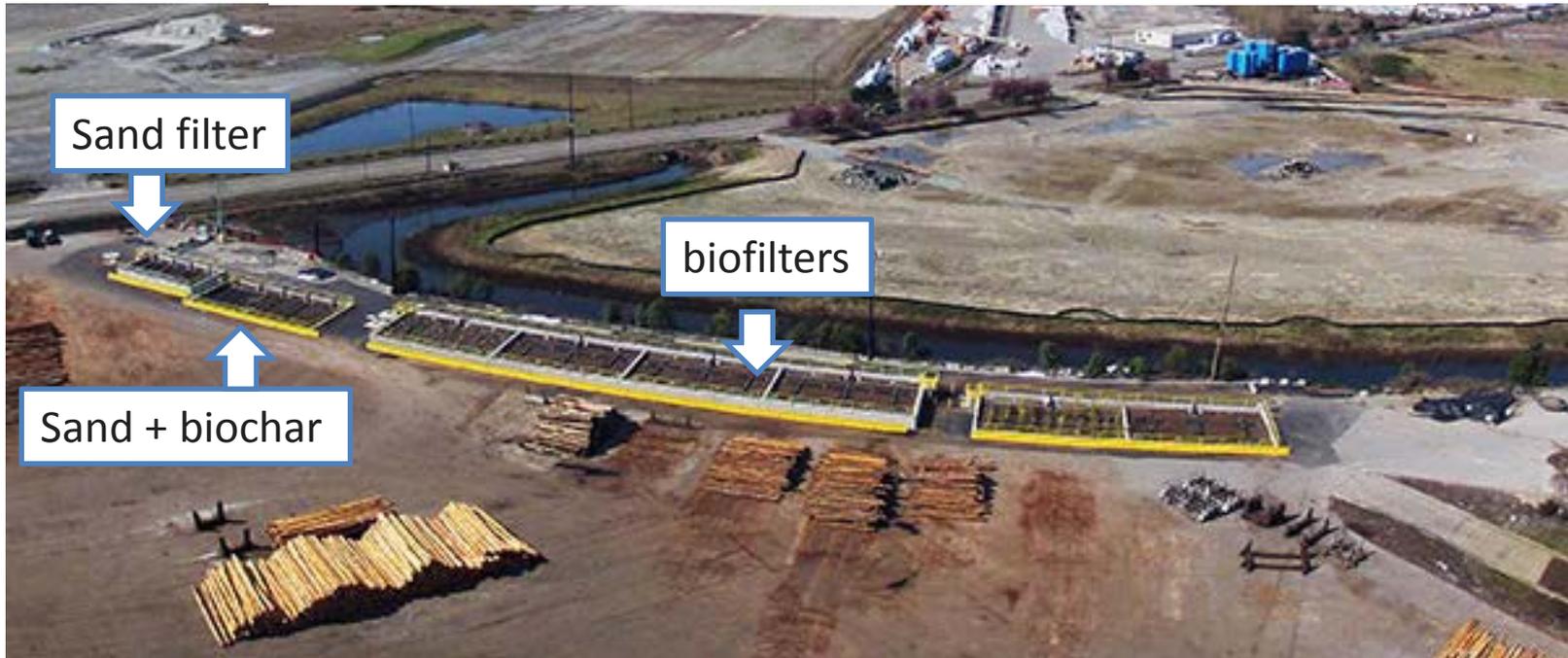


Photo: Kennedy Jenks, Port of Tacoma, West Hylebos Pier Log Yard

Up to 80% - 90% reduction in ISGP parameters: pH, Zinc, Copper, Turbidity, TSS & COD

Small Scale tests: 70% Sand + 30% Biochar to capture Copper and reduce Chemical Oxygen Demand (COD)

Biochar Improves Water Quality



LOW IMPACT DESIGN:RAIN GARDENS/STORM DRAINS

WSU Low Impact Development Center



DEMOS: 8 Cities
RESEARCH:

- OSU – MS, MBA
- EPA Corvallis
- WSU Puyallup
- Stanford/CSM



ROOF DRAINS



BIOCHAR IN COMPOST ROLLS AND BIO BAG FILTERS FOR SURFACE RUNOFF

Toxics & Organics Filtered by Biochar

Peer reviewed research shows the following toxic organics are sorbed by biochar.

- **Heavy Metals:** Copper, Zinc, Lead, Cadmium, Chromium, Mercury
- **Explosives:** DNT, TNT, RDX
- **Herbicides:** Atrazine, Acetochlor, Clopyralid, Fipronil, Glyphosate, Simazine, 2,4D, Trifluralin, Diuron (DCMU)
- **Solvents:** Benzonitrile, Trichloroethylene, Triazine
- **Hydrocarbons:** oil, gas
- Poly chlorinated biphenyls (**PCB**)
- **Pesticides & Fungicides:** Pyrimethanil, Hexachlorobenzene, Pentachlorophenol, Lindane, Isoproturon, Endosulfan, Chlorantraniliprole, Chlorpyrifos, Carbofuran
- **Polycyclic Aromatic Hydrocarbons (PAH)**
 - >50% of 4- & 5- ring PAH
 - >40% of 2- & 3- PAH (e.g. Phenathrene)

Literature Search: sciencedirect.com

Make Biochar to Suit the Purpose

Some Applications Require Processed Biochars

DIY BIOCHAR



INDUSTRIAL BIOCHAR



***SELECT BIOCHARS TO SUIT
SOILS AND CROP NEEDS***

Opportunities are emerging for Biochar Off the Farm and in Urban Applications

- **Off Farm**

- Trees, Nurseries
- Turf, Erosion Control, Soil Remediation
- Stormwater and water quality

- **Urban**

- Green roof, urban farm, garden, structural soil



www.biochar.bioenergylists.org

TR Miles Technical Consultants, Inc.

1470 SW Woodward Way

Portland, OR 97225

tmiles@trmiles.com

www.trmiles.com

503-292-0107

503-780-8185 mobile

Design and development of energy and environmental processes

Industries

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Pollution control
Materials handling
Feed, Food and Fuels**

