Use of Portable Field Kilns to Process Biomass and Make Biochar

Potter Valley Tribe Project Update

September 22, 2021

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Potter Valley Tribe

30 CELEBRATING YEARS SONOMA ECOLOGY CENTER

NORTH COAST RESOURCE PARTNERSHIP

CALIFORNIA CLIMATE INVESTMENTS

Cap and Trade Dollars at Work

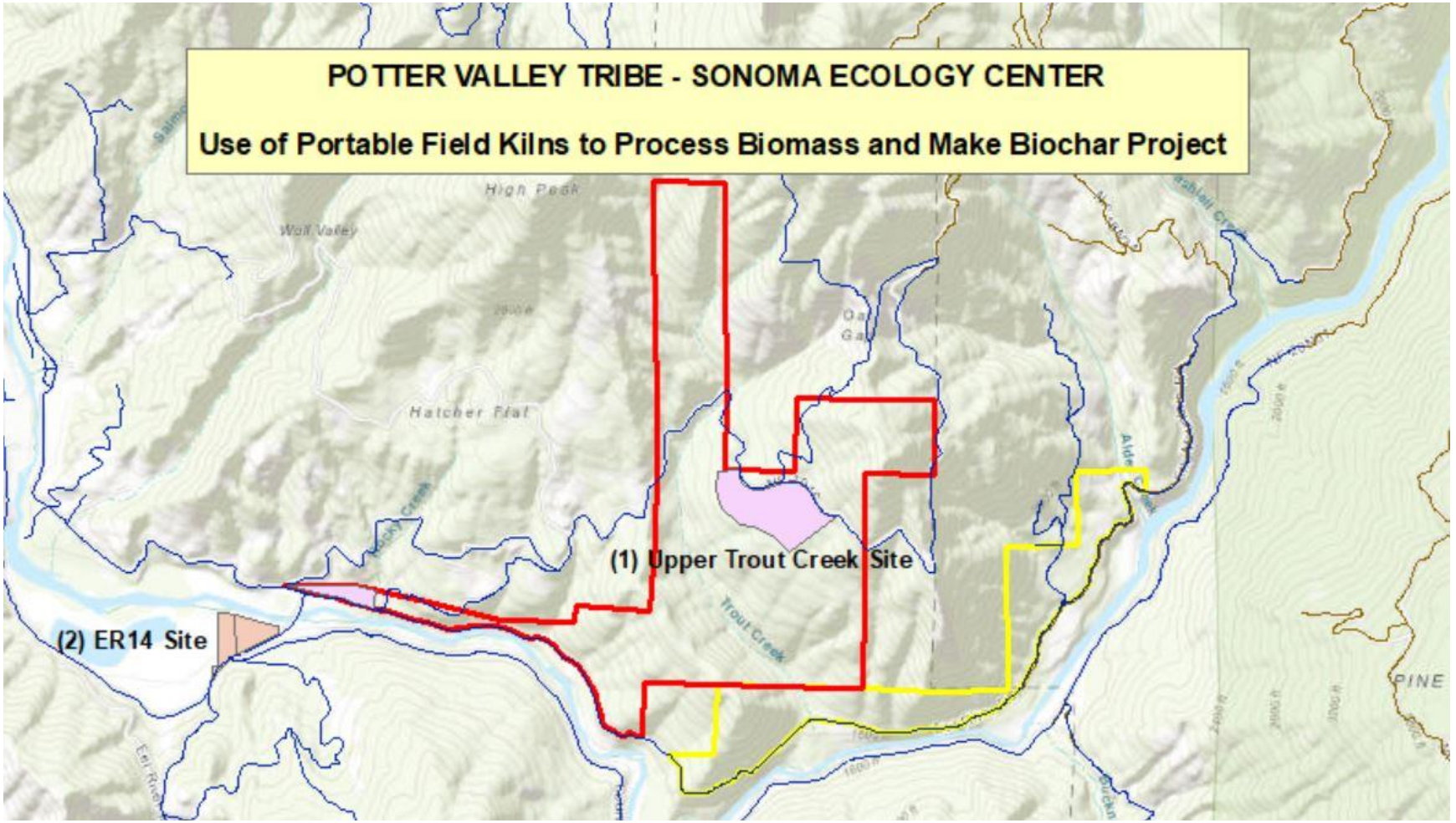
FOREST BIOCHAR PRODUCTION DEMONSTRATION 4/23/2021

- Sponsors: Sonoma Ecology Center, Potter Valley Tribe
- A demonstration for local tribes, agencies, residents, and interested pubic
- Under a grant from the North Coast Resource Partnership, with assistance from the California Conservation Corps, Ukiah Center

Hard Work, Low Pay,
Miserable Conditions and More

The Potter Valley Tribe owns & manages property from the Pacific Ocean to Lake County

The Potter Valley Tribe has forested properties in the Eel River area in need of fuels reduction



Overgrown forest in a portion of the 678 acre Trout Creek site:

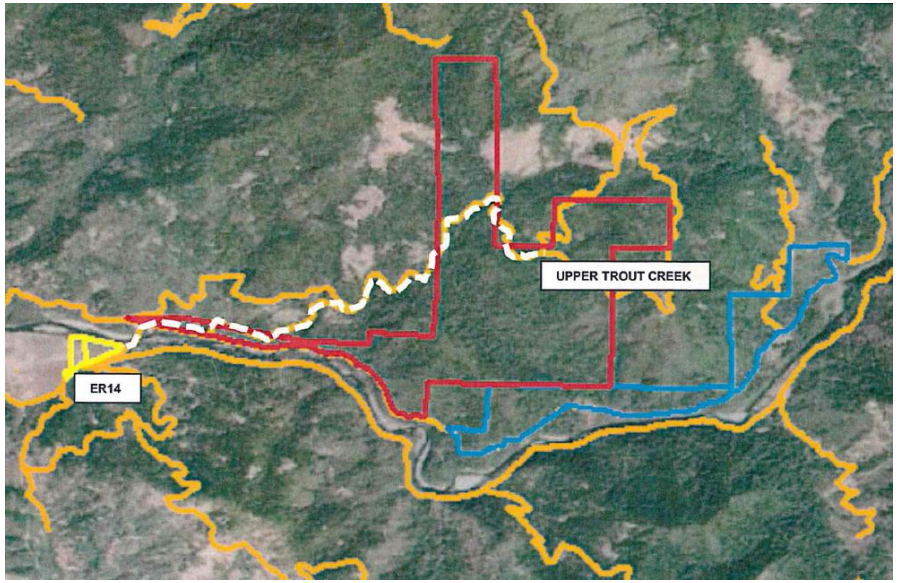
The California Conservation Corps provided crews for fuels reduction/thinning of the PVT Upper Trout Creek Property

A total of 3.7 acres was thinned in 1 week; 950 person-hours

Thinning for fuels reduction, old growth and wildlife enhancement:

After:

The Tribal crew stacked materials, then gathered & hauled them down to the staging area, the PVT ER14 property, next to the Eel River bridge.



Materials were cut and stacked for drying (2-3 weeks in this case). Volume and moisture content were measured.

Demonstration Day April 23, 2021

- Attendance – 16 (including presenters)
- 5 Indian Tribes represented: Potter Valley Tribe, Coyote Valley NSN, Pinoleville Pomo Nation, Round Valley Indian Tribes, Robinson Rancheria
- 5 Agencies: UC Ag & Natural Resources, Sound Native Plants, Mendocino Land Trust, Sonoma Ecology Center, Potter Valley Tribe Environmental Office
- 3 local property owners

Fire & air quality permits obtained from the County of Mendocino

FACILITY ID #
49278

PERMIT NUMBER
4025870

INTER-AGENCY BURN PERMIT

Call (707) 463-4391 for Burn Day Status Prior to Burning

PERMIT AND PROCEDURES FOR OPEN OUTDOOR BURNING FOR PILES LARGER THAN 4 X 4

THIS PERMIT DOES NOT AUTHORIZE BURNING DURING THE 'BURN BAN'

THE 'BURN BAN' IS APPROXIMATELY JULY 1 THROUGH THE END OF THE DECLARED FIRE SEASON

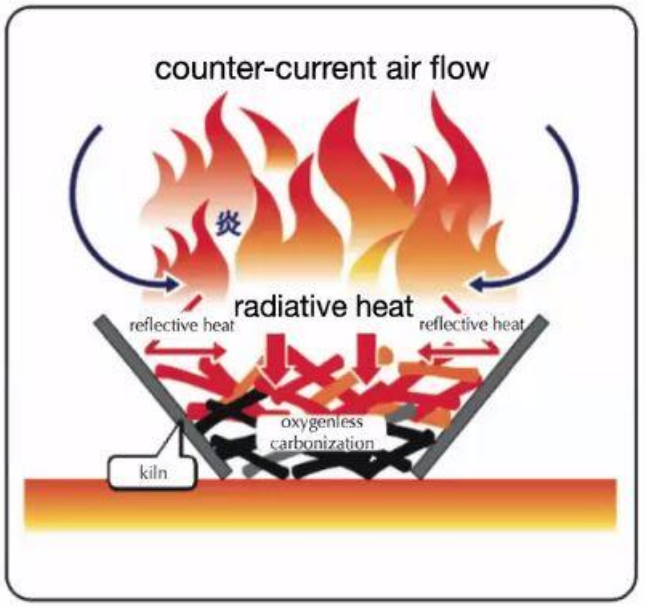
This permit is valid only on days when agricultural burning is not prohibited by the California Air Resources Board, pursuant to Health and Safety Code, Section 14855, or Mendocino County Air Quality Management District Regulation 2, Rule, 2-600(a). All open outdoor burning shall comply with all applicable local, county and state regulations. This permit is not valid for any burning conducted in violation of Mendocino County Air Quality Management District Regulation 2 and Mendocino County Code, Chapter 9.33, Ordinance 3746. Ordinance 3746 allows the burning of vegetative matter only. The Uniform Fire Code, Section 1102.3.3 prohibits the burning of paper products.

The teacher: Cuauhtemoc Villa, a regenerative ag teacher from the Portland, Oregon area and expert in biochar production and use

The kilns were assembled (2 Ring of Fire units) and loaded with wood < 4 inches

Water source needed; the PVT water truck

Igniting from the top



Burning; low smoke; high oxygen

Water added to extinguish

Sides removed; biochar spread to water & extinguish char

Biochar can be spread on site or moved to another site for use

The Crew

Progress since April, 2021

- 2 areas have been cleared for biochar production at the PVT upper Trout Creek site
- Staging of some of the materials thinned from the 3.7 acre TC site
- Plans for staging and covering much of the material for after the rains start

Total Biomass from Fuels Reduction

BIOCHAR PROJECT – BIOMASS PRODUCED TO AUGUST, 2021

WOODY BIOMASS	DESCRIPTION	Cubic feet		TOTALS
		ER14	Up TC	
B	Brush, conifer & broadleaf	960	480	1440 cf
K	Kindling, < 2 inch diameter	1264	240	1504 cf
SW	Staged Wood, < 4 inch; 4 ft long	3008	2400	5408 cf
W	Wood, firewood, > 4 inch	32	565	597 cf = 4.7 cords
P	Poles, >4 inch; 5-10 ft long	8 ea	75 ea	83 Poles = 91 cf
TOTAL BIOMASS (thinned from forest)				**9032 cf**
TOTAL POTENTIAL BIOMASS >> BIOCHAR				**6912 cf**

Analysis of Biochar and Effects on Soil

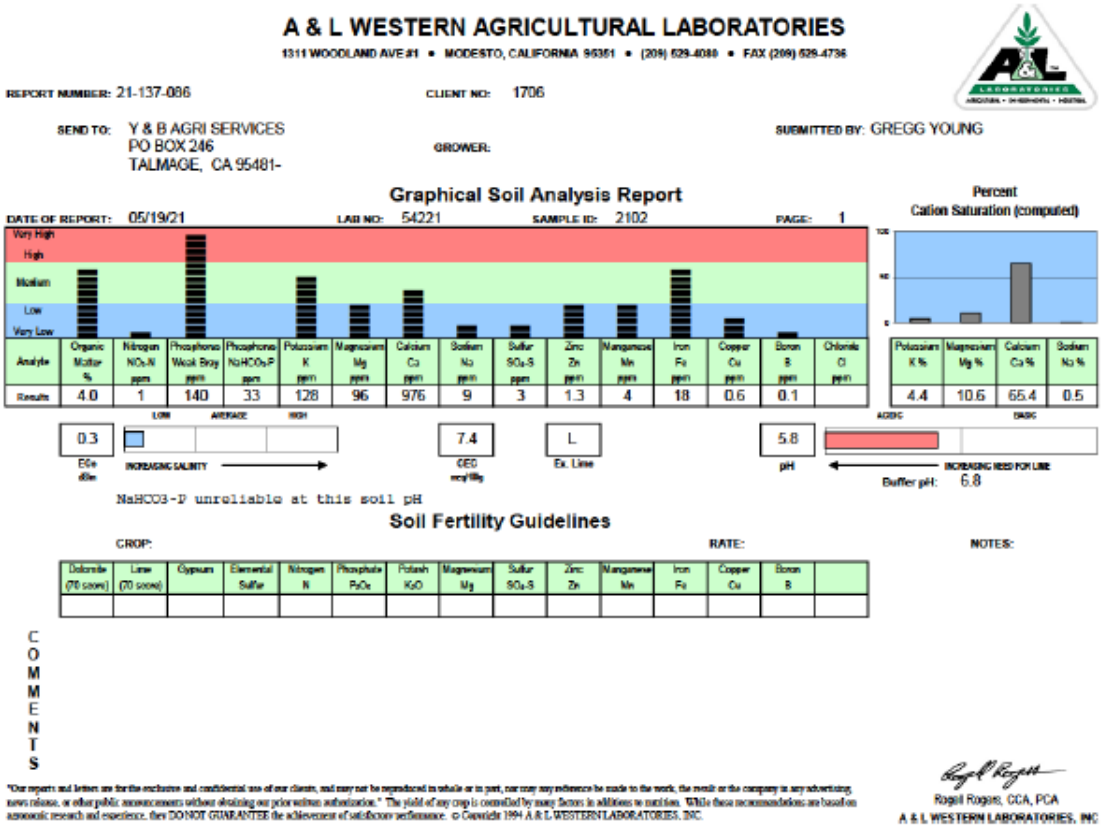
- To measure the effects of biochar on the soil, composite samples were taken from areas with the biochar on top and from the surrounding soil. Depth = 6 inches

Analysis of Brush and Effects on Soil

- Samples were analyzed of the brush (pine needles, leaves, twigs, & branches 1/8 inch or less) to measure the nutrients that would be left on the forest floor if not turned to biochar. These would be turned to ash upon burning (releasing soluble nutrients)

- For lab results, sampling methodology and results interpretation, contact Gregg Young, Environmental Director of the Potter Valley Tribe and Certified Professional Agronomist at:

  pvtepadirector@pottervalleytribe.com



A & L WESTERN AGRICULTURAL LABORATORIES

1311 WOODLAND AVE #1 • MODESTO, CALIFORNIA 95351 • (209) 529-4080 • FAX (209) 529-4736

REPORT NUMBER: 21-137-086 CLIENT NO: 1706

SEND TO: Y & B AGRI SERVICES
PO BOX 246
TALMAGE, CA 95481-

GROWER:

SUBMITTED BY: GREGG YOUNG

Graphical Soil Analysis Report

DATE OF REPORT: 05/19/21 LAB NO: 54221 SAMPLE ID: 2102 PAGE: 1

Very High
High
Medium
Low
Very Low

Analyte	Organic Matter %	Nitrogen NO_3-N ppm	Phosphorus Weak Bray ppm	Phosphorus $NaHCO_3$-P ppm	Potassium K ppm	Magnesium Mg ppm	Calcium Ca ppm	Sodium Na ppm	Sulfur SO_4-S ppm	Zinc Zn ppm	Manganese Mn ppm	Iron Fe ppm	Copper Cu ppm	Boron B ppm	Chloride Cl ppm
Results	4.0	1	140	33	128	96	976	9	3	1.3	4	18	0.6	0.1	

LOW AVERAGE HIGH

0.3 ESp dSm INCREASING SALINITY

7.4 CEC meq/100g

L Ex. Lime

5.8 pH ACIDIC BASIC INCREASING NEED FOR LIME

Buffer pH: 6.8

Percent Cation Saturation (computed)

Potassium K %	Magnesium Mg %	Calcium Ca %	Sodium Na %
4.4	10.6	65.4	0.5

$NaHCO_3$-P unreliable at this soil pH

Soil Fertility Guidelines

CROP: RATE: NOTES:

Dolomite (70 score)	Lime (70 score)	Gypsum	Elemental Sulfur	Nitrogen N	Phosphate P_2O_5	Potash K_2O	Magnesium Mg	Sulfur SO_4-S	Zinc Zn	Manganese Mn	Iron Fe	Copper Cu	Boron B	

COMMENTS

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Rogell Rogers, CCA, PCA
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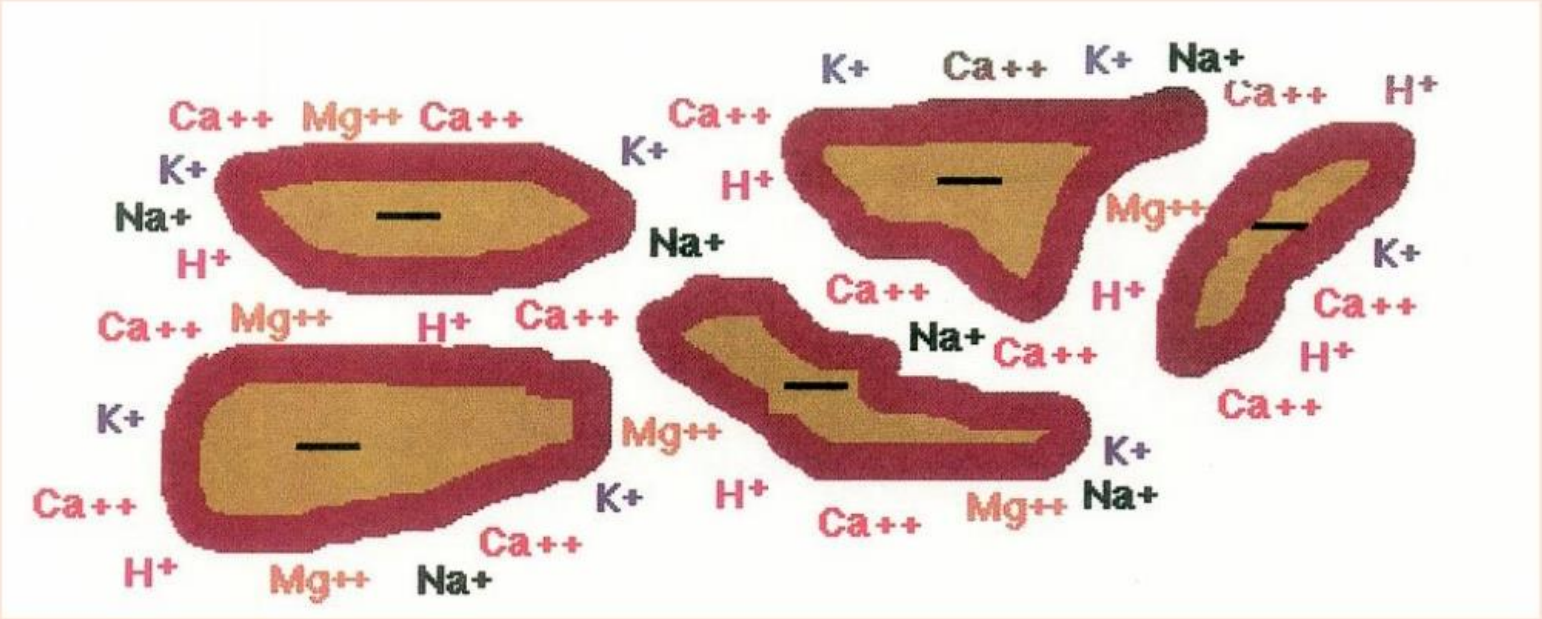
Cation Exchange Capacity (CEC) – Clay & Humus (and Biochar)

Base Cation Saturation Ratio

- The amounts and ratios of the major cations on the clay/organic matter EXCHANGE SITES



Background Soil Basic Characteristics:

Background soil–depth 0 to 6 inches; includes grass/organic matter on surface.

- This is a light-textured, sandy loam soil, CEC of 7.4 with an acid 5.8 pH and 4.0% organic matter content. Ratios of major cations show: Low calcium: optimum magnesium: optimum potassium: low sodium. Nitrate nitrogen is very low; phosphorus is very high; potash is near optimum; sulfur is low. Micronutrients show abundant iron; with zinc, manganese, copper and boron all on the low side. Limestone is needed at rates of 0.8 tons per acre foot.
- Organic matter content would normally test lower, as surface OM is usually not incorporated into the sample.

Basic Characteristics

- **Background soil** –This is a typical, highly leached, acid soil, common in the area. With the light texture, calcium and micronutrients are leached out due to high rainfall; iron is abundant due to the high Fe content on the surrounding hills. Available water content is 1.2 inches/foot (41.3% estimated water holding capacity).

The soil is very compacted from 50 years of sawmill operation on the site

Biochar Amended Basic Characteristics:

- **Biochar-amended soil**–depth 0 to 6 inches; includes 1 inch of onsite-produced biochar on surface.
- This is a light-textured, sandy loam soil, CEC of 7.0 with slightly acid, 6.4 pH and 4.5% organic matter content (see note on this). Ratios of major cations show: optimum calcium: optimum magnesium: optimum potassium: with low sodium. Nitrate nitrogen is very low; phosphorus is high; potash is near optimum; sulfur is low. Micronutrients show abundant iron; with zinc, manganese, copper and boron all on the low side. No limestone is needed to raise calcium level. Iron is abundant due to the high Fe content on the surrounding hills. Available water content is 1.3 inches/foot (44.3% estimated water holding capacity).

General Recommendations

- **Background soil**–For most crops except native plants and timber, limestone would be needed to raise calcium level, improve nutrient availability (especially nitrogen), and buffer excess acidity. Phosphorus fertilization would not be needed; micronutrient fertilization might be needed, except for iron, which is abundant. Maintenance of organic matter and addition of nitrogen would be best for production.

Soil + Biochar soil –This soil is well balanced for most crops; the BSCR/ratios of the major cations (Ca, Mg, K, Na) can have significant impacts on soil structure, drainage, biological activity, and nutrient availability. The addition of the 1 inch of biochar to the surface has made these conditions optimum relative to the background soil. This soil would just need the addition of nitrogen and possibly micronutrients (except iron). Phosphorus fertilization would not be needed.

Note: The high organic matter level (4.5%) in the biochar-amended soil is somewhat misleading, as the lab test measures carbon released upon ignition. So, the biochar would not contain active organic matter that would release nutrients and form a lot of humus. However, biochar has been shown to serve as a substrate for biological activity and has a cation exchange capacity that would provide nutrient exchange, improve water holding capacity, and assist with the slow release of nutrients due to its many sites for colonization by soil microbes and as an oxygen, carbon dioxide, and water reservoir.

Biochar as a soil amendment: The difference in water holding capacity is 7% more in the biochar-amended soil. This may not be the best measure of this, since the biochar was left on the surface and not incorporated into the soil. It would provide a significant mulch when used in this manner, which would increase water retention through reduced evaporation. Further amending the biochar soil with compost or a biological inoculant would make a very productive site with proper soil preparation to eliminate the compaction.

The biochar from this batch weighed about 360 pounds/cu yard

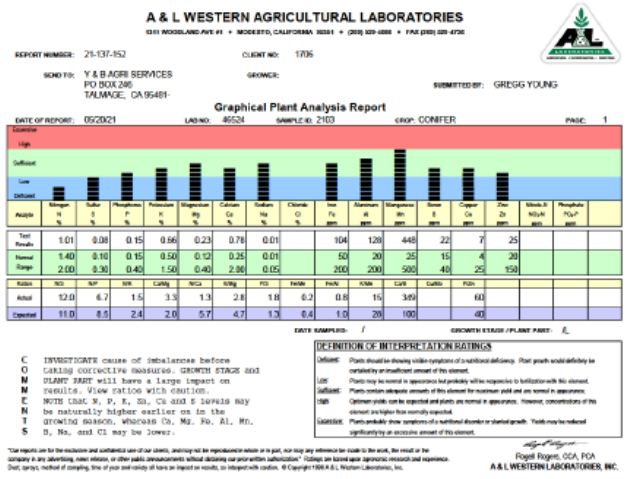
Biochar Ash as a soil amendment: The Biochar Ash would provide calcium (2.9 #/t), potassium (1.7 #/t) and magnesium (1.3 #/t) in mostly low amounts; with low to moderate amounts of micronutrients. It would serve as a good source of manganese. The high pH (10.1) is most likely a reflection of oxides, hydroxides, and carbonates of calcium, potassium, magnesium, and sodium. These would change to bicarbonates of those same cations after enough rainfall; rain provides dissolved carbon dioxide, which is carbonic acid, the most common acid in nature. As a soil amendment it would give best results at rates of 10+ tons/acre

Summary:

- The addition of the biochar to the surface of the soil at the ER14 site would accomplish the following:
- Sequester up to 80% of the carbon from the forest thinning project
- Balance the major soil cations to near-optimum levels
- Reduce the hydrogen ion concentration by ±10% (raise pH)
- May increase water retention (7%) and reduce evaporation loss

Analysis of brush/needles

- These samples were taken to determine the nutritional contribution of the brushy components of forest thinning biomass when burned (or completely decomposed). For this analysis, twigs 1/8” or less with leaves or needles were sampled at random from piles, dried, and submitted to the lab. Optimum nutrient levels for conifers were requested and shown on the report from A&L Western Laboratories.



A & L WESTERN AGRICULTURAL LABORATORIES

REPORT NUMBER: 21-137-152 CLIENT NO: 1705

SEND TO: Y & B AGRI SERVICES
PO BOX 246
TALMAGE, CA 95481

GROWER:

SUBMITTED BY: GREGG YOUNG

Graphical Plant Analysis Report

DATE OF REPORT: 05/20/21 LAB NO.: 46524 SAMPLE ID: 2103 CROP: CONIFER PAGE: 1

Analysis	Nitrogen N %	Sulfur S %	Phosphorus P %	Potassium K %	Magnesium Mg %	Calcium Ca %	Sodium Na %	Chloride Cl %	Iron Fe ppm	Aluminum Al ppm	Manganese Mn ppm	Boron B ppm	Copper Cu ppm	Zinc Zn ppm	Weak B Mo/W ppm	Phosphate H2oP ppm
Test Results	1.01	0.08	0.15	0.66	0.23	0.78	0.01		104	128	448	22	7	25		
Normal Range	1.40 2.00	0.10 0.30	0.15 0.40	0.50 1.50	0.12 0.40	0.25 2.00	0.01 0.05		50 200	20 200	25 500	15 40	4 25	20 150		

Ratios	N/S	N/P	N/K	Ca/Mg	N/Ca	K/Mg	P/S	Fe/Mn	Fe/Al	K/Mn	Ca/K	Ca/Mn	Fe/Zn
Actual	12.0	6.7	1.5	3.3	1.3	2.8	1.8	0.2	0.8	15	349		60
Expected	11.0	8.5	2.4	2.0	5.7	4.7	1.3	0.4	1.0	28	100		40

DATE SAMPLED: / GROWTH STAGE / PLANT PART: E

COMMENTS: INVESTIGATE cause of imbalances before taking corrective measures. GROWTH STAGE and PLANT PART will have a large impact on results. View ratios with caution. NOTE that N, P, K, Zn, Cu and S levels may be naturally higher earlier on in the growing season, whereas Ca, Mg, Fe, Al, Mn, B, Na, and Cl may be lower.

DEFINITION OF INTERPRETATION RATINGS

Deficient: Plants should be showing visible symptoms of a nutritional deficiency. Plant growth would definitely be curtailed by an insufficient amount of this element.

Low: Plants may be normal in appearance but probably will be responsive to fertilization with this element.

Sufficient: Plants contain adequate amounts of this element for maximum yield and are normal in appearance.

High: Optimum yields can be expected and plants are normal in appearance. However, concentrations of this element are higher than normally expected.

Excessive: Plants probably show symptoms of a nutritional disorder or stunted growth. Yields may be reduced significantly by an excessive amount of this element.

Rigel Rogers, CCA, FCA
A & L WESTERN LABORATORIES, INC.

Brush/Needles/Leaves Results:

Nitrogen –on the low side, even for conifers, which are generally lower than broadleaves in total N
Sulfur, Phosphorus, Potassium –also on the low side
Magnesium –in the middle range; most North Coast soils are high in Mg, not surprising.
Calcium –on the low side; most area soils are low in Ca. Leaves are generally higher than twigs in Ca; and broadleaves are higher than needles
Sodium –low; these soils are highly leached, so this is expected

Micronutrients – all within optimum range; expected since area forest soils are high in micronutrients, especially iron and manganese. The red color of local mountain soils is typical of high iron forest soils

References:

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