

Soil amendments for nitrogen and water management: cover crops, compost and biochar



SOLANO
Resource
Conservation
District

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Soil/water goals in an ag system:

- Provide sufficient water for the crop
- Minimize water use in the dry months
- Minimize standing water or flooding in the wet months
- Recharge groundwater/improve infiltration
- Minimize nutrient/contaminant loss to surface water and groundwater

All of these are improved with increased
soil organic matter (carbon)



Easiest ways to increase soil organic matter

- Cover crops (annual or perennial)
- Compost
- Weeds



Other interesting ways to increase soil organic matter

- Biochar
- Minimize tillage
- Biosolids
- Trees



Cover Crop Heebie Jeebies

Extra field ops/expense

One more thing to manage

Prevent spring soil heating and exacerbate frost

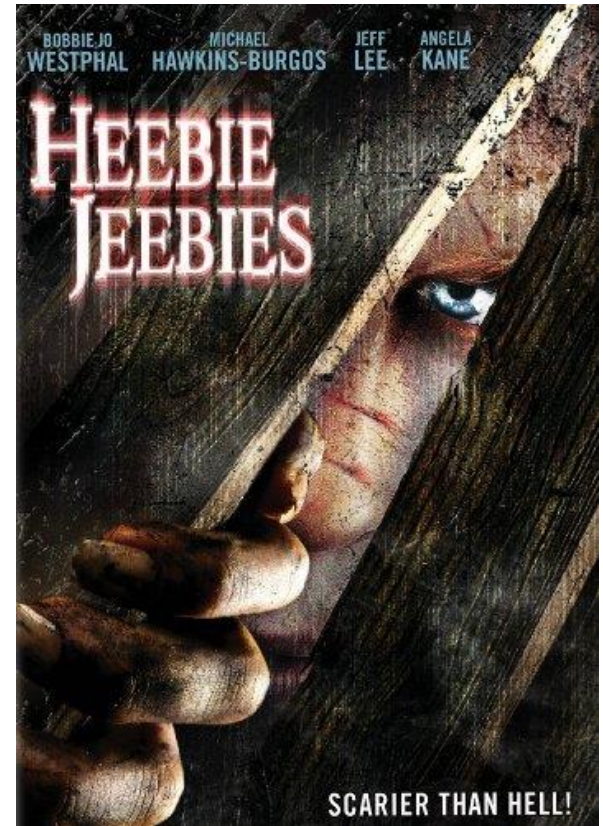
Keep ground too wet in the spring

Take available soil water from the primary crop

Make harvest difficult

Attract unwanted insects/pathogens

Attract rodents



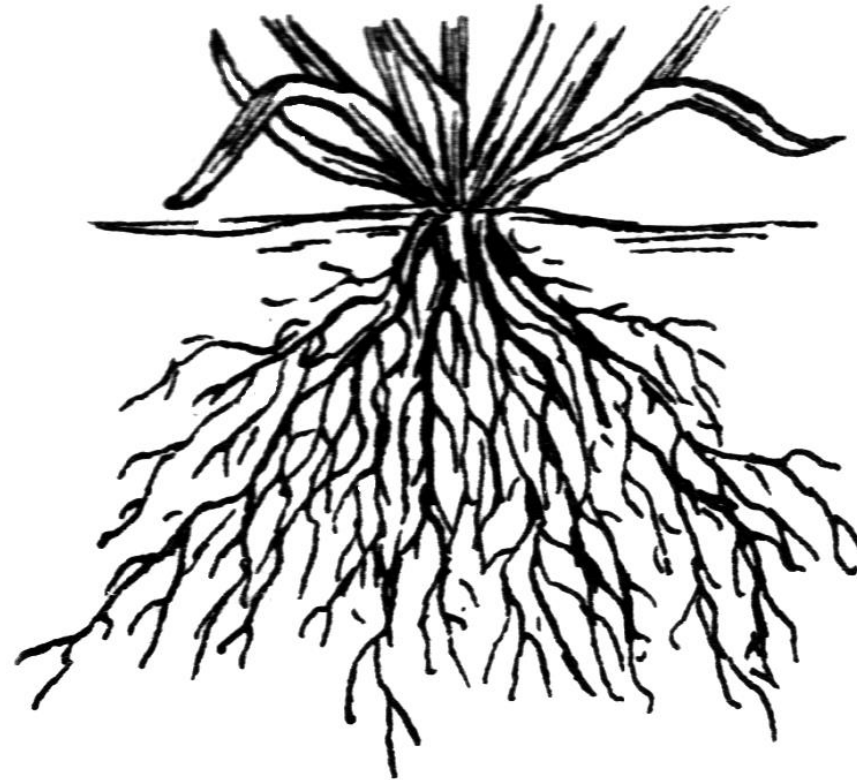
But we love them anyway, because they.....

Contribute organic matter to the soil

Improve soil water holding capacity

Improve soil water infiltration

Reduce soil erosion

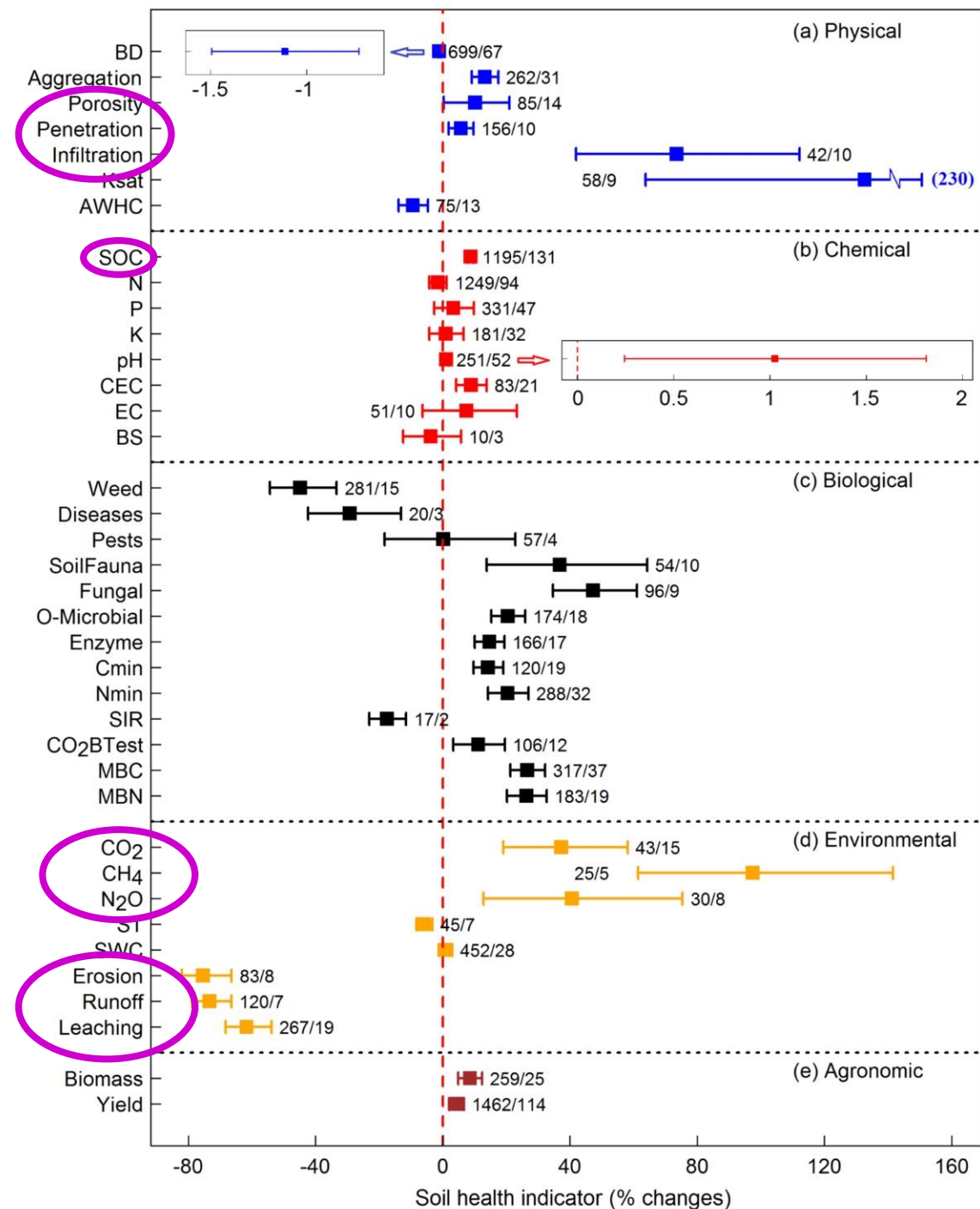


Contribute nitrogen and micronutrients to soils and crops

Shade out weeds

Take carbon out of the atmosphere and put it in the soil

A recent review of published studies on the effects of cover crops on soil health measures shows significant benefits in cover cropped systems



From: J Jian, B Lester, X Du, M Reiter, R Stewart. 2020. A calculator to quantify cover crop effects on soil health and productivity. Soil and Tillage Research 199: 104575.

Compost

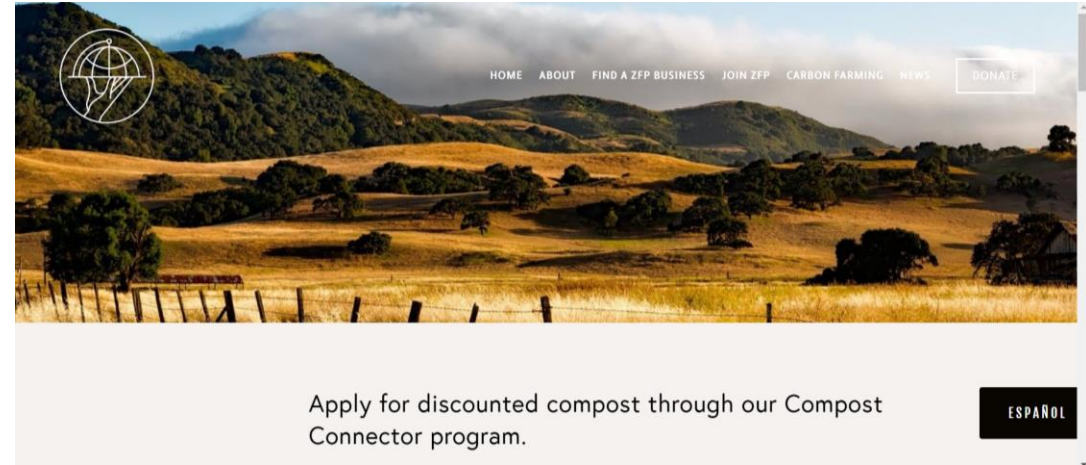
- Incorporated or surface-applied
- Variable in C:N ratio, contaminant levels, nutrient content and moisture content
- Increases soil organic matter, water holding capacity, nutrient availability



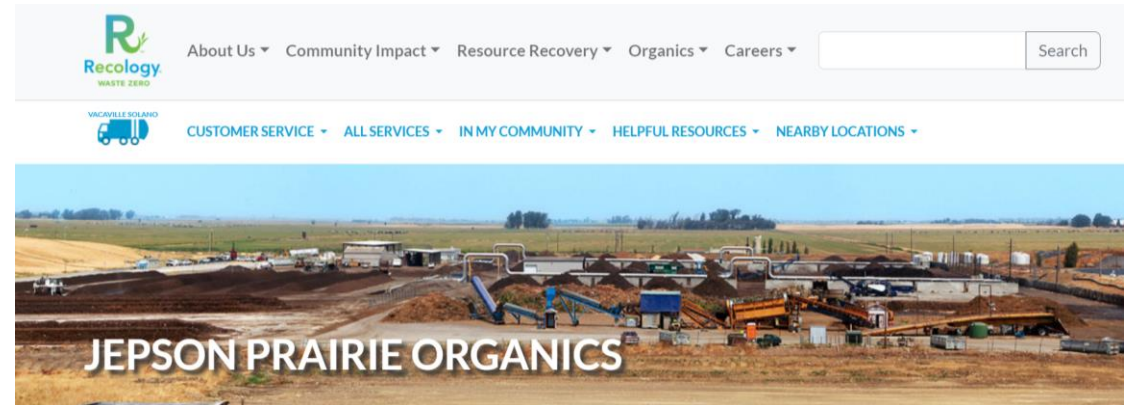
Photo: Ramon Barreiro

If you are looking for compost....

Zero Foodprint's Compost Connector program



Compost facility at Hay Road landfill



Also available at Napa Recycling and Waste Services, other Central Valley locations

If you are **STILL** looking for compost....

(We may be able to help you get some!)

1. SB 1383 mandates that jurisdictions collecting curbside green waste (cities and counties) must make finished compost available, free of charge, to their residents. The amounts required are based on population, and meeting those requirements will require moving some of that compost out to farms.
2. State funding focused on healthy soils/regenerative agriculture is providing major financial incentives to apply compost on farms and ranches.



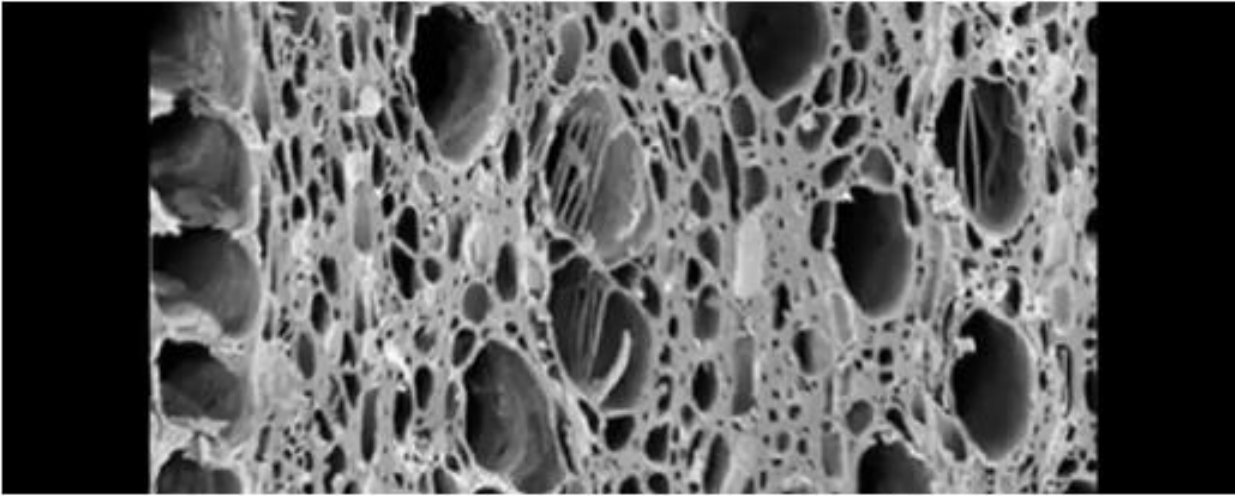
(ask for Amy or Kevin)

Biochar

- Created by incinerating organic material (wood) at very high temps in low/no oxygen (pyrolysis)
- Leaves a carbon skeleton (charcoal) with exceptionally high surface area for adsorbing water and nutrients



Photo: K.salo.85



From: acarbons.com

- Increases soil water holding capacity
- Filters contaminants from soil
- Sequesters carbon by growing plants and then burying their carbon in a very stable form (100s – 1000s of years) in the soil

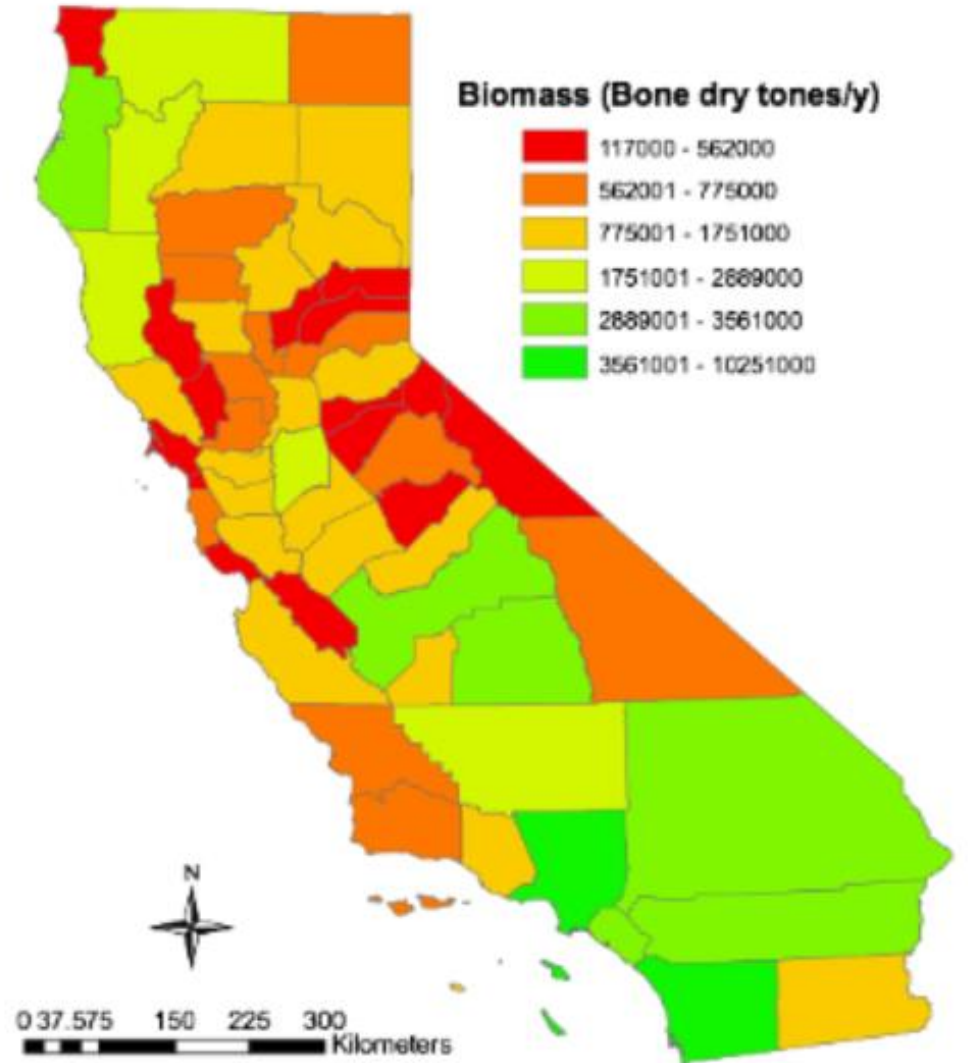


Figure 3. Amount of biomass produced annually in counties in the state of California, US (Commission, 2007).

Table 1. List of active biochar producers in California.

| Biochar producers, City | Year started | Products | Commercial product | Focus application sector | Main feedstock | Status |
|---|--------------|---|----------------------------|----------------------------------|--------------------------------------|---------|
| Genesis industries, Redondo Beach | 2011 | Reactors, biochar | Biochar and bio-stimulants | Farming and gardening | Nutshells, urban green waste | Phase 2 |
| Pacific biochar, Santa Rosa | 2014 | Biochar | BlackLite | Agriculture | Woody residues | Phase 3 |
| Biorotectech, Redwood City | 2012 | Reactors, biochar | Soil mix pro | Organic waste management | Biosolids, manure, green waste | Phase 2 |
| Carbo culture, Woodside | 2017 | Biochar (green landscaping) | Carbon services | Climate & soil, landscaping | Forestry waste | Phase 1 |
| Full circle biochar, San Francisco (bio365 LLC) | 2007 | Biochar | BioCore and BioCharge | Agriculture | Wood waste from timber industry | Phase 1 |
| Blue sky biochar, Thousand Oaks | 2010 | Biochar | SEEK fertilizer | Agriculture | Pine, bamboo | Phase 2 |
| Cool planet energy systems, Camarillo | 2009 | Biochar | CoolTerra | Agriculture | Farm residues | Phase 2 |
| Energy Anew IMC, San Rafael | 2005 | Biochar (solar-powered) | Biocharm | Vegetables, flowers, fruit trees | Wood chips | Phase 2 |
| Interra energy, INC, San Diego | 2009 | Biochar, fuels, reactor | Interra Preta | Agriculture, biofuels | Trimming, wood, timber & green waste | Phase 2 |
| All power labs, Berkeley | 2007 | Reactors, biochar, blends | Chartainer, power pallet | Local carbon network | Woody residues | Phase 2 |
| Phoenix energy, San Francisco | 2006 | Reactors, biochar | Reactor | Agriculture | Forest and woody residues | Phase 2 |
| Tolero energy, LLC, Sacramento | 2009 | Reactors, biochar, fuels, activated carbons | Tolero fuel | Transportation, water treatment | Urban biomass residues | Phase 2 |

From: Thengane et al 2021. Market prospects for biochar production and application in California. Biofuels, Bioproducts and Biorefining.

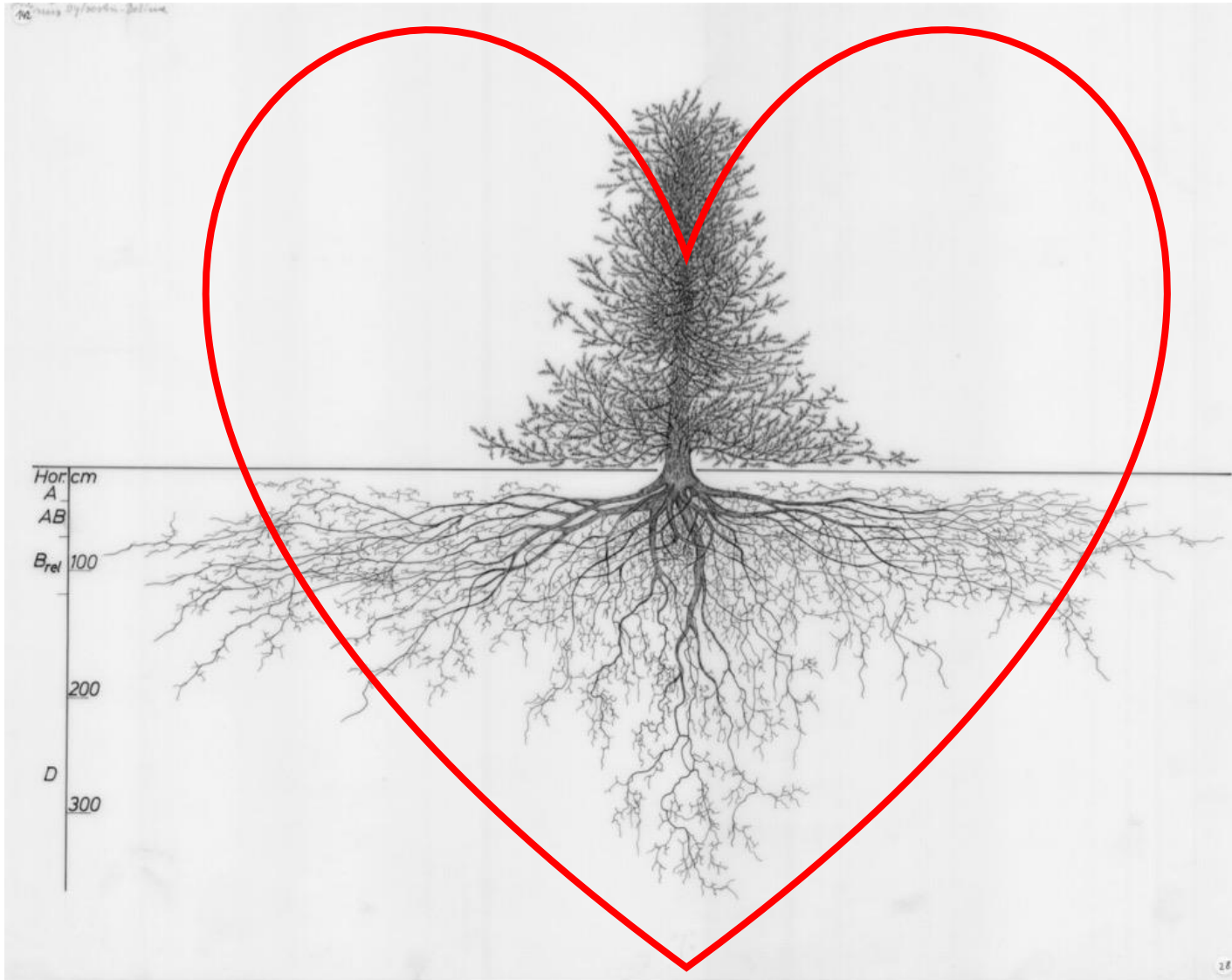
Table 2. Annual biochar production and application potential in different sectors of California.

| | | |
|--|-------|--------------------------------|
| Biochar production | | |
| Total biomass available (agriculture + forest) | 52.26 | Million BDT |
| Total accessible biomass available (agriculture + forest) ²⁰ | 23.52 | Million BDT |
| Total biochar production (20% conversion) | 4.70 | Million BDT |
| Biochar application | | |
| Agriculture and forestry | | |
| Land covered by biochar application (1 BDT/acre) | 4.70 | Million acres |
| Time required to cover total agricultural land of state | 5.38 | Years |
| Time required to cover total forest land of state | 7.02 | Years |
| GHG reduction | | |
| State total GHG annual emissions ⁴⁹ | 424.1 | Million-ton CO ₂ -e |
| State GHG annual emissions in agriculture sector ⁴⁹ | 32.23 | Million-ton CO ₂ -e |
| Biochar carbon sequestration potential (average biochar carbon content: 70%) ³⁵ | 12.08 | Million-ton CO ₂ -e |
| Soil N ₂ O emission reduction (1 BDT/acre application) ⁵⁰ | 0.22 | Million-ton CO ₂ -e |
| Portion of total state GHG emissions in agriculture sector | 38.16 | % |

| | | |
|--|-------|--------------------------------|
| Groundwater | | |
| State annual water consumption in agriculture ⁵¹ | 11.08 | Trillion gallons |
| Water holding capacity increment (2% (w/w) biochar application) ⁵² | 7275 | Gallons/acre |
| Total increased water holding ⁵² | 0.39 | Trillion gallons |
| Portion of total water consumption in agriculture | 3.54 | % |
| Wastewater treatment | | |
| State annual wastewater generation ⁵³ | 1.46 | Trillion gallons |
| Portion of wastewater treated by biochar (0.51 kg/m ³) ⁵⁴ | 43.24 | % |
| Livestock feed and manure management | | |
| Livestock feed (1% biochar in daily feed w/w ⁵⁶ ~ 0.39 million BDT biochar) | | |
| Enteric fermentation (20% GHG reduction ⁵⁵) | 2.27 | Million-ton CO ₂ -e |
| Manure management (13.6% w/w biochar in manure ~4.31 million BDT biochar) | 11.07 | Million-ton CO ₂ -e |
| Portion of total state GHG emissions in agriculture sector | 41.38 | % |

From: Thengane et al 2021. Market prospects for biochar production and application in California. Biofuels, Bioproducts and Biorefining.

A word on trees:



- Can occupy farm edges, non-arable land, roadsides
- Create tremendous networks of sub-surface channels to improve soil water infiltration and groundwater recharge
- Pull CO₂ out of the air while so doing

How can we help?



- Cover crops, compost, biochar
- Hedgerows, riparian forest, wildlife nesting boxes and perches
- Fencing and troughs to keep cattle off waterways
- Irrigation system evaluations
- Groundwater recharge basins
- Fire-safe land management
- Creek management and flood prevention
- Carbon farm plans

We can work with you to plan projects and find funds to implement them!

To chat about water or dirt or plants, any time!

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