







Regional and National Scale of Forest Restoration

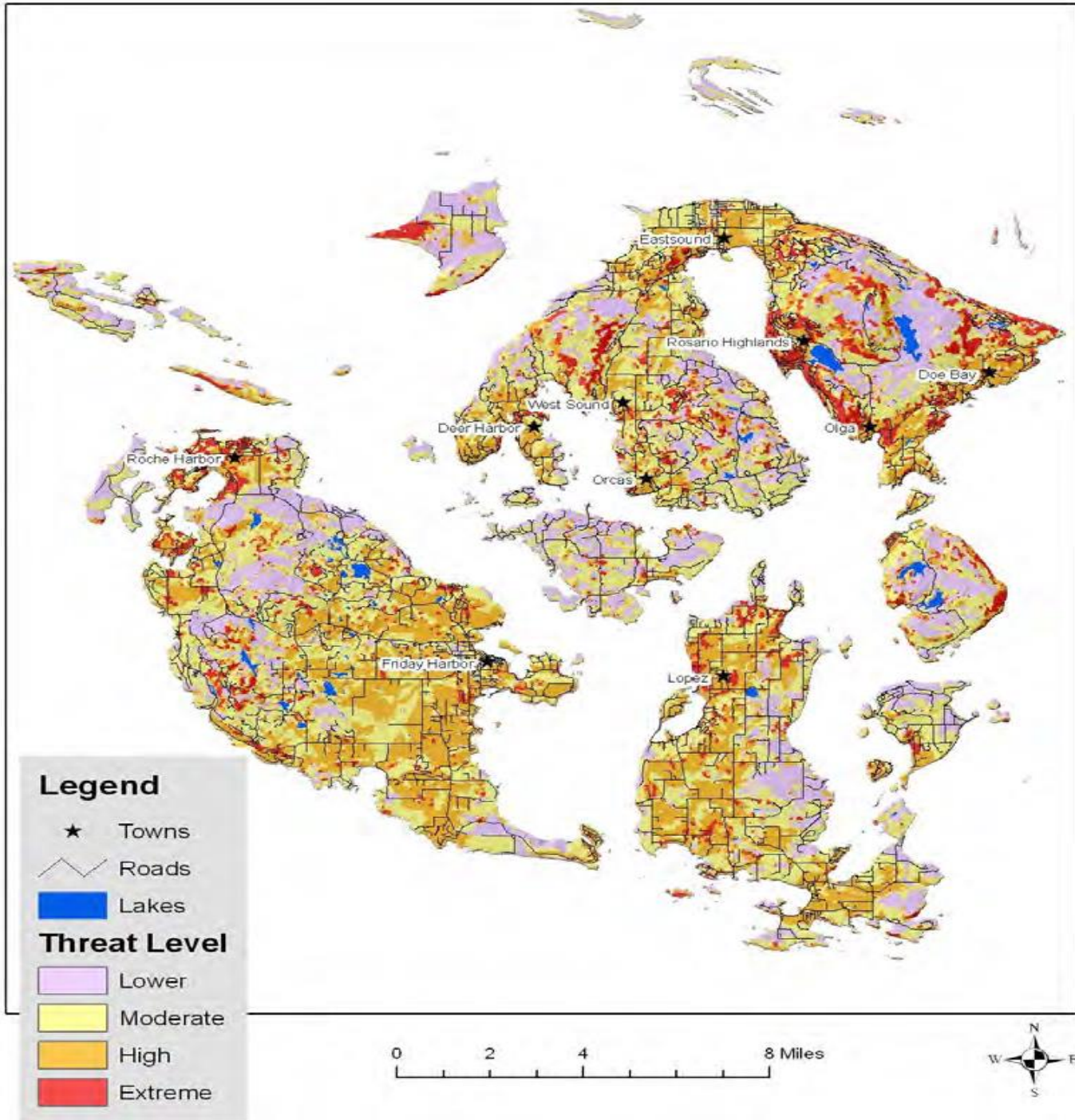
- 9.5 million forested acres in need of restoration in the Washington and Oregon (Haugo et al. 2015)
- In the 15 western United States, more than 28 million acres in need of fuel reduction, yielding approximately 345 million oven-dry tons from accessible areas (Rummer et al. 2003).
- Over 100 million acres of forest in need of restoration in the United States (Fry, Western Forest Conservation)



Forest Fires Nationally

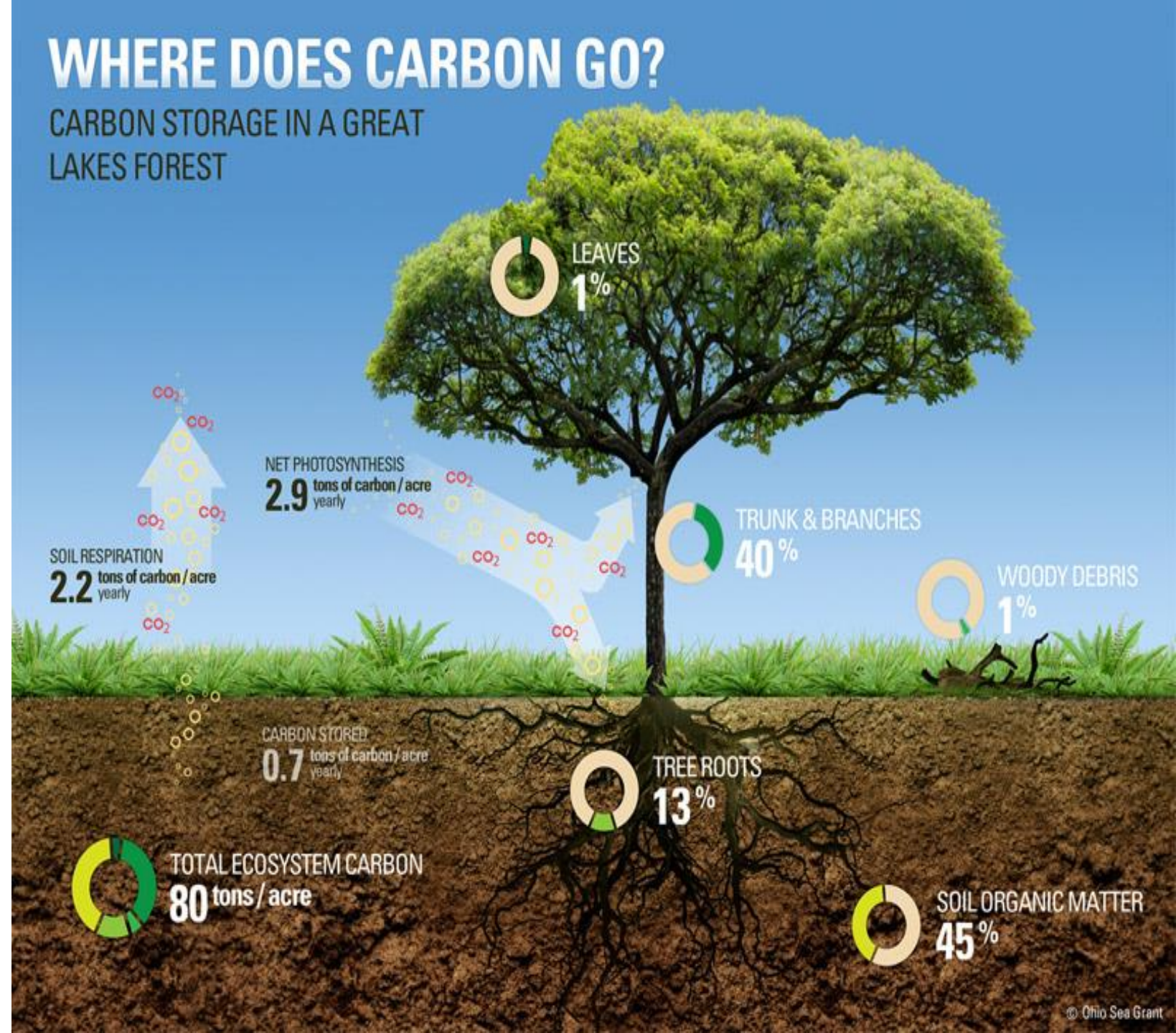
- 73 million acres burned over the last 10 years (Fry, Western Forest Conservation)
- Forest Fires produce 5% of the total CO₂ emitted annually by fossil fuel burning (DeLuca, 2017)





Forests and the Carbon Cycle

- Forest Fires produce 5% of the total CO₂ emitted annually by fossil fuel burning (DeLuca, 2017)



Old Growth Fires

- 4-6% of biomass in old growth forest fires is converted into charcoal
- Prairie ecosystems converted rootball mass into 20-40% charcoal



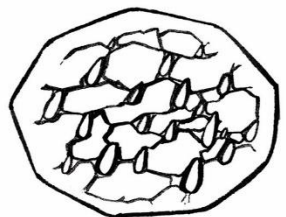
CHARCOAL'S ROLE in SOIL RESILIENCY

Charcoal stores the carbon that plants absorb in a stable form that lasts in soils for up to 10,000 years, keeping it from the atmosphere and providing benefits in our soils for millennia



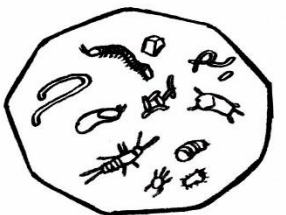
PLANT GERMINATION

Charcoal's black color warms soils in early spring



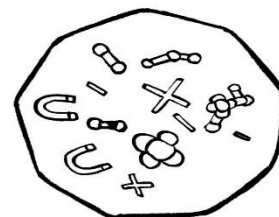
WATER RETENTION

Charcoal's absorptive structure provides increasing stability in soil moisture



SOIL BIOLOGY

Charcoal has been shown to increase soil microbes that process minerals, resulting in plants absorbing higher amounts of nutrients



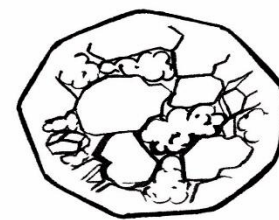
NUTRIENT RETENTION

Each micropore holds an electrical charge that bonds with soil nutrients to keep minerals in the topsoil layers



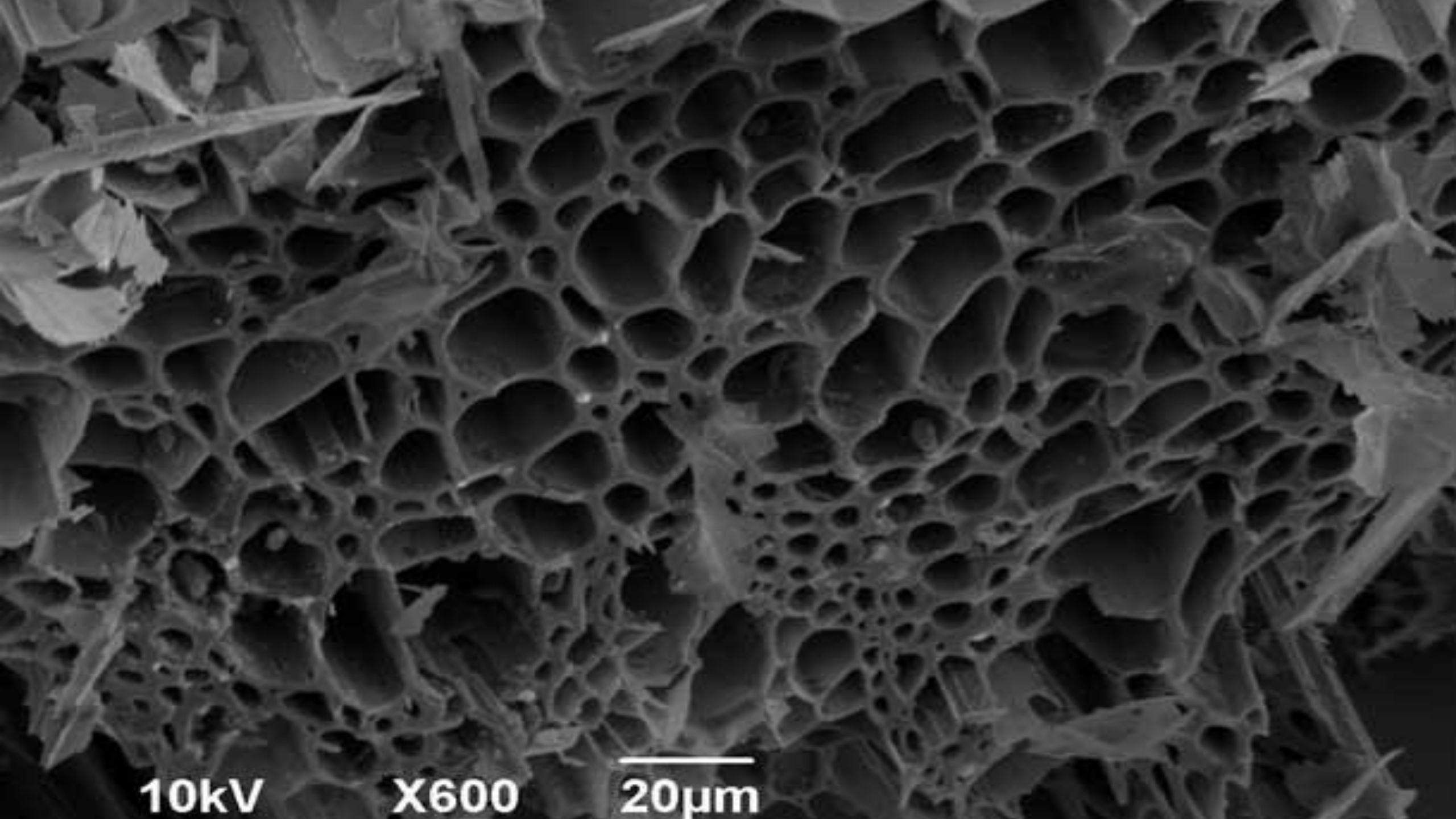
ORGANIC MATTER

Charcoal's micropores absorb organic matter



OXYGENATION

Micropores increase soil oxygenation, beneficial for saturated growing areas



10kV

X600

20μm

Carbon Offgassing

- The Ohio State for Carbon Sequestration estimates that agricultural fields globally have lost between 50-70% of their original carbon



- <https://vimeo.com/20211517/b7f0da76fb>

Cylinder Burn

- Low tech and low cost
- Allows for continuous feed of material, allowing operators to process more fuel



Pyrolysis

- Charcoal is produced in a low oxygen environment
- The fire box keeps oxygen from accessing the coals underneath



Terra Preta de Indigo



Example of Forestry-Farm Integration

- Photo series from Nootka Rose Farm on Waldron Island



Material

- Material is organized by size
- Dry fuel creates hotter burns, with desired temperature between 850 to 1,000 degrees F



Branches

- Branch material holds the highest concentration of nutrients
- Small diameter wood burns hotter and more uniform



Post processing

- Charcoal should be pulverized to maximize surface area for biological benefit
- We char down before pulverizing as the dust can be harmful to your lungs



Application

- Apply at $\frac{3}{8}$ th of an inch on the ground or 5%-10% of soil volume in the top 6 inches of soil
- Fertilizer can be added at this time

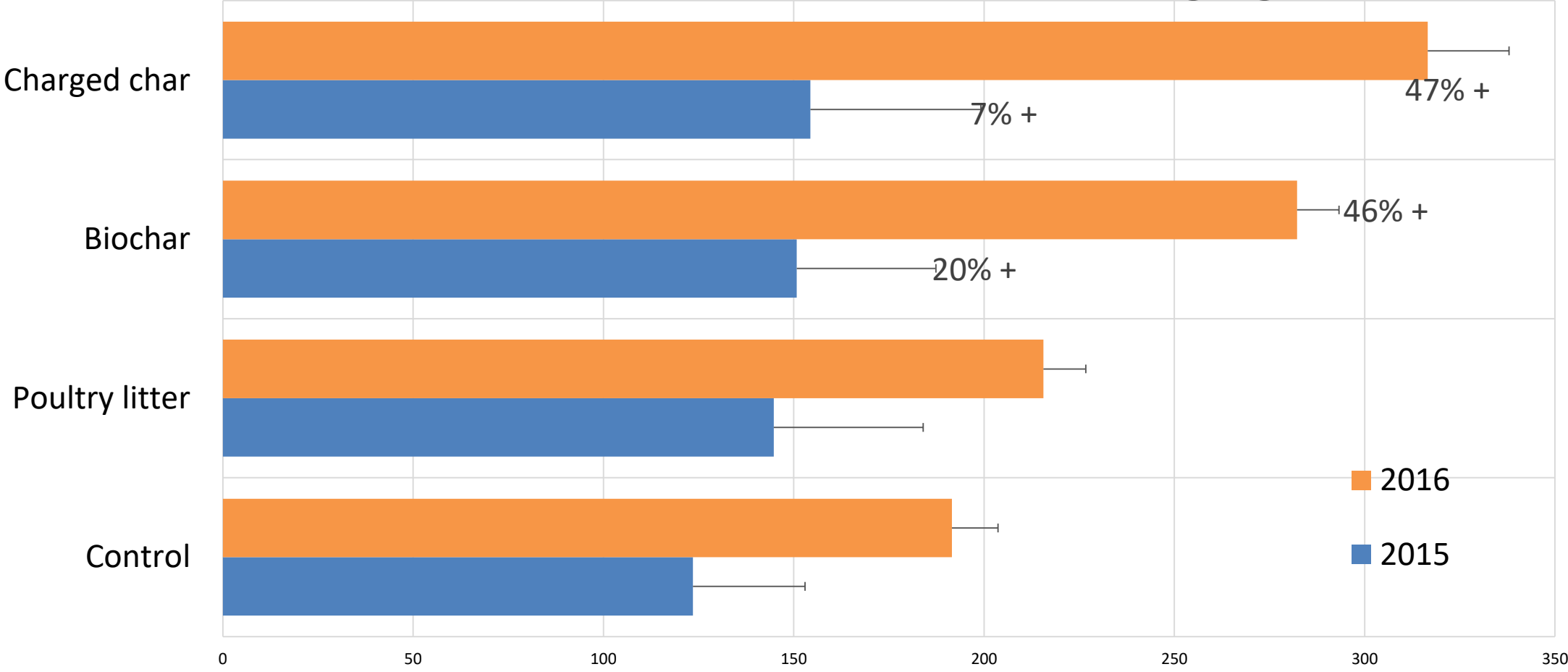


Scale

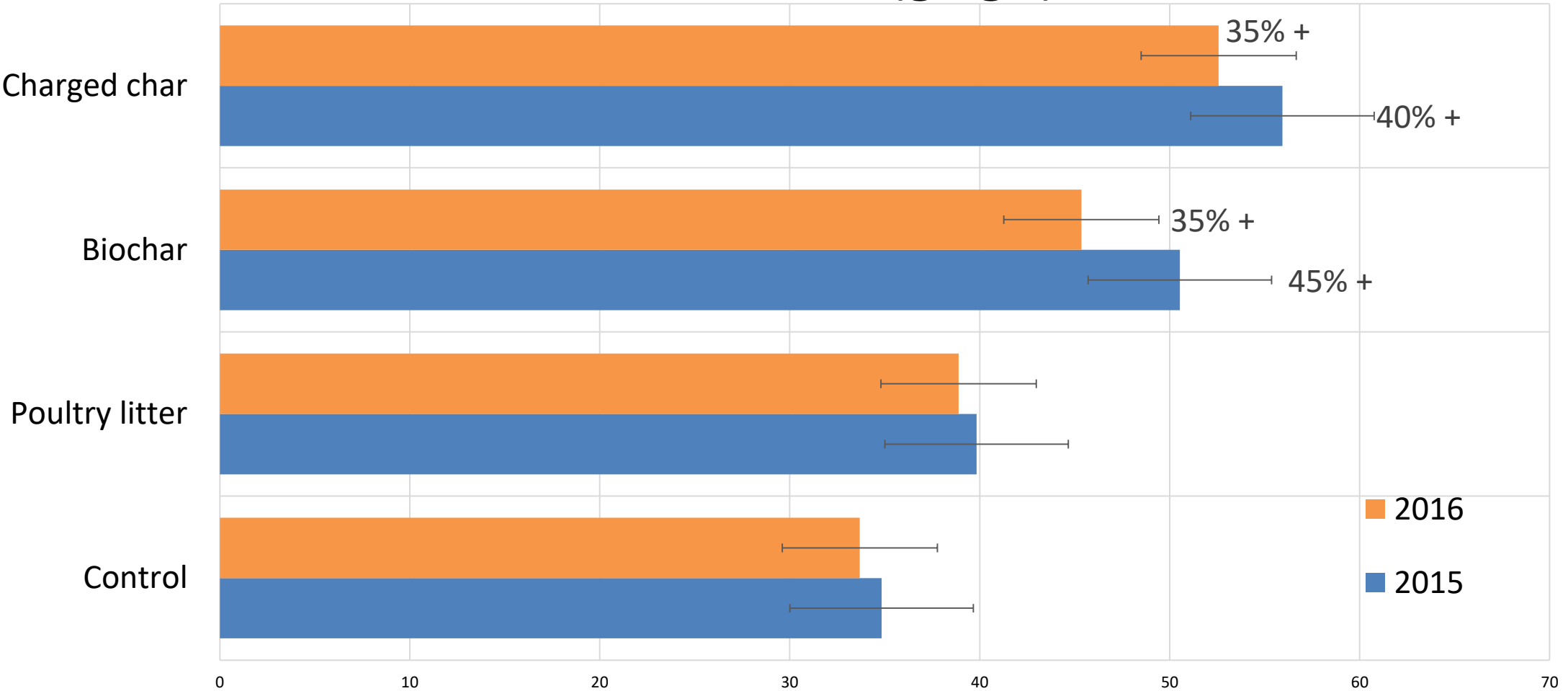
- 1 day, with 3 kilns, produced enough char to cover 1/4 on an acre.
- 1 and done application: this material will last for up to 10,000 years



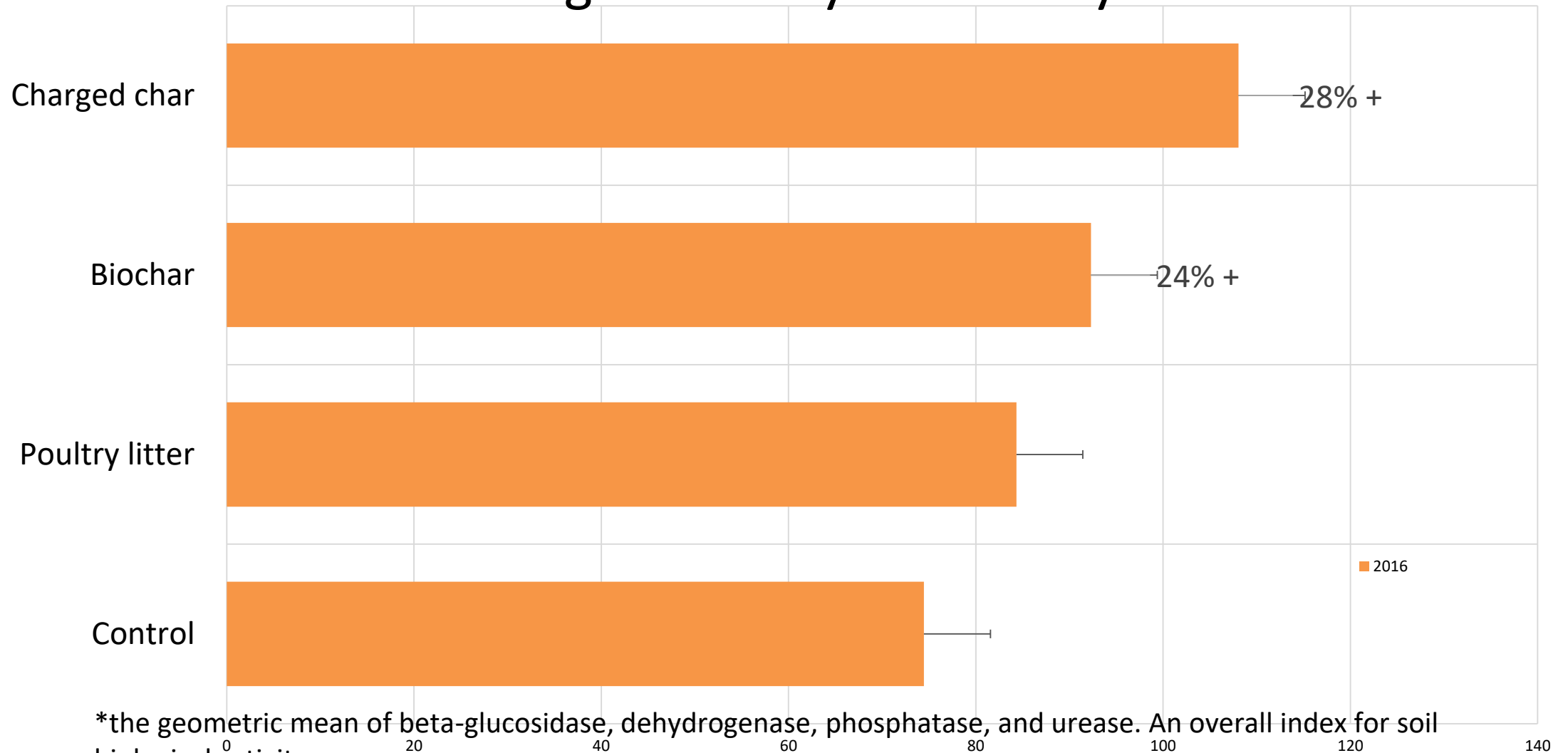
Soil microbial biomass C (mg kg⁻¹)



Soil total C (g kg⁻¹)

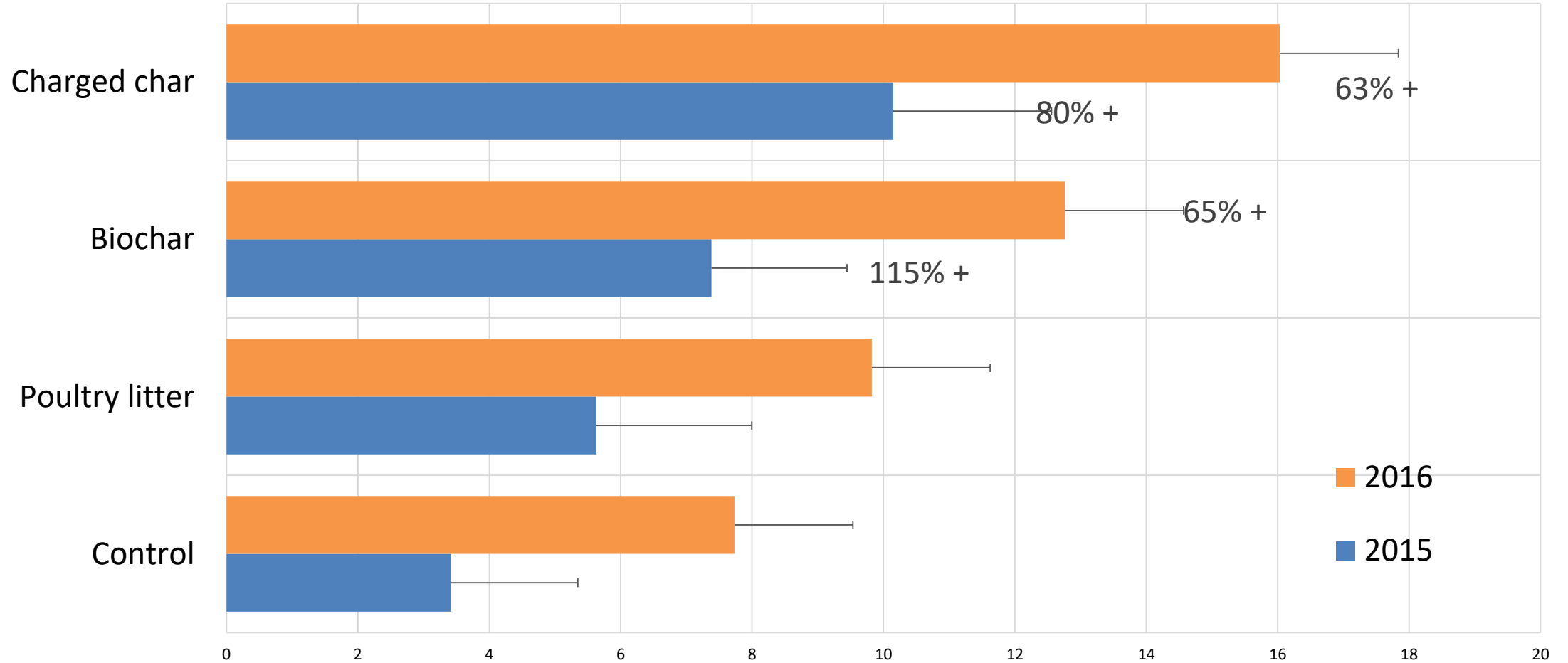


Average soil enzyme activity*

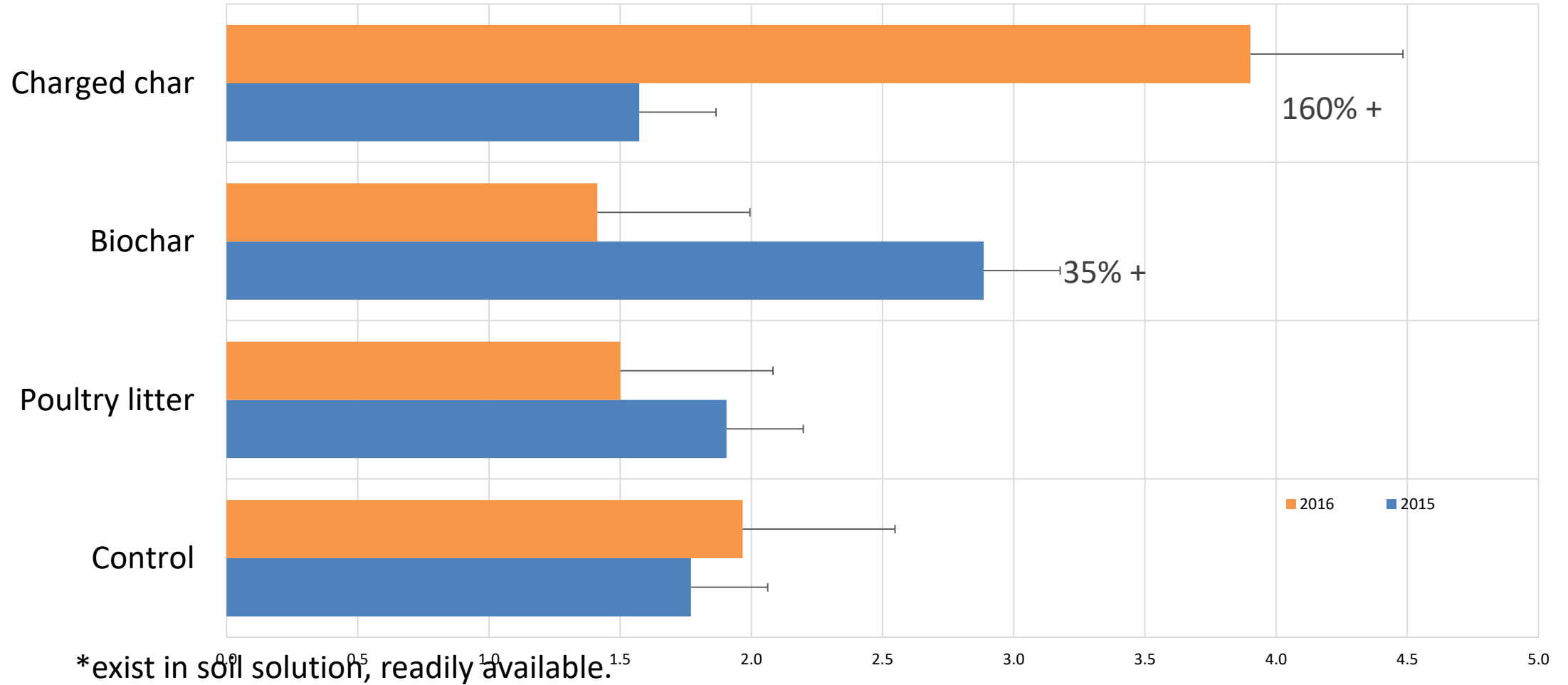


*the geometric mean of beta-glucosidase, dehydrogenase, phosphatase, and urease. An overall index for soil biological activity.

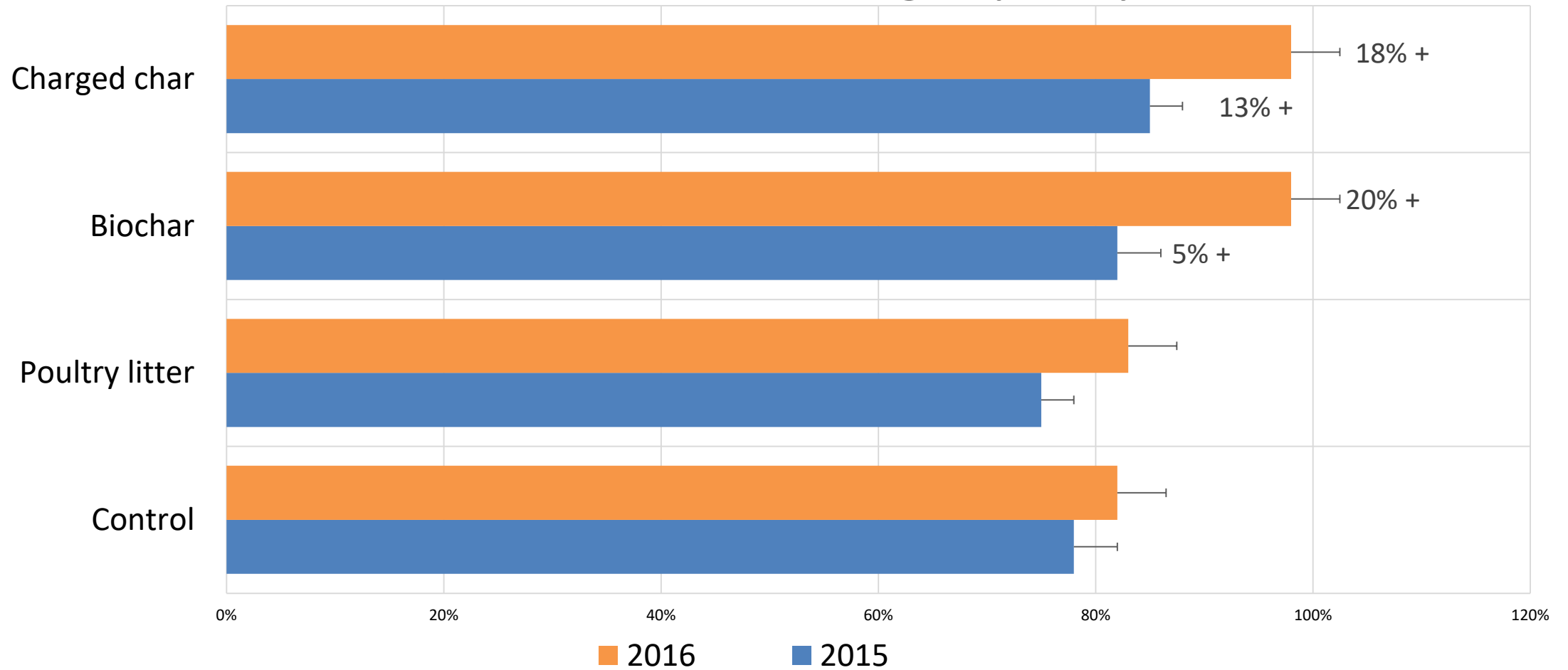
Soil potentially mineralizable N (mg kg⁻¹ 14d)



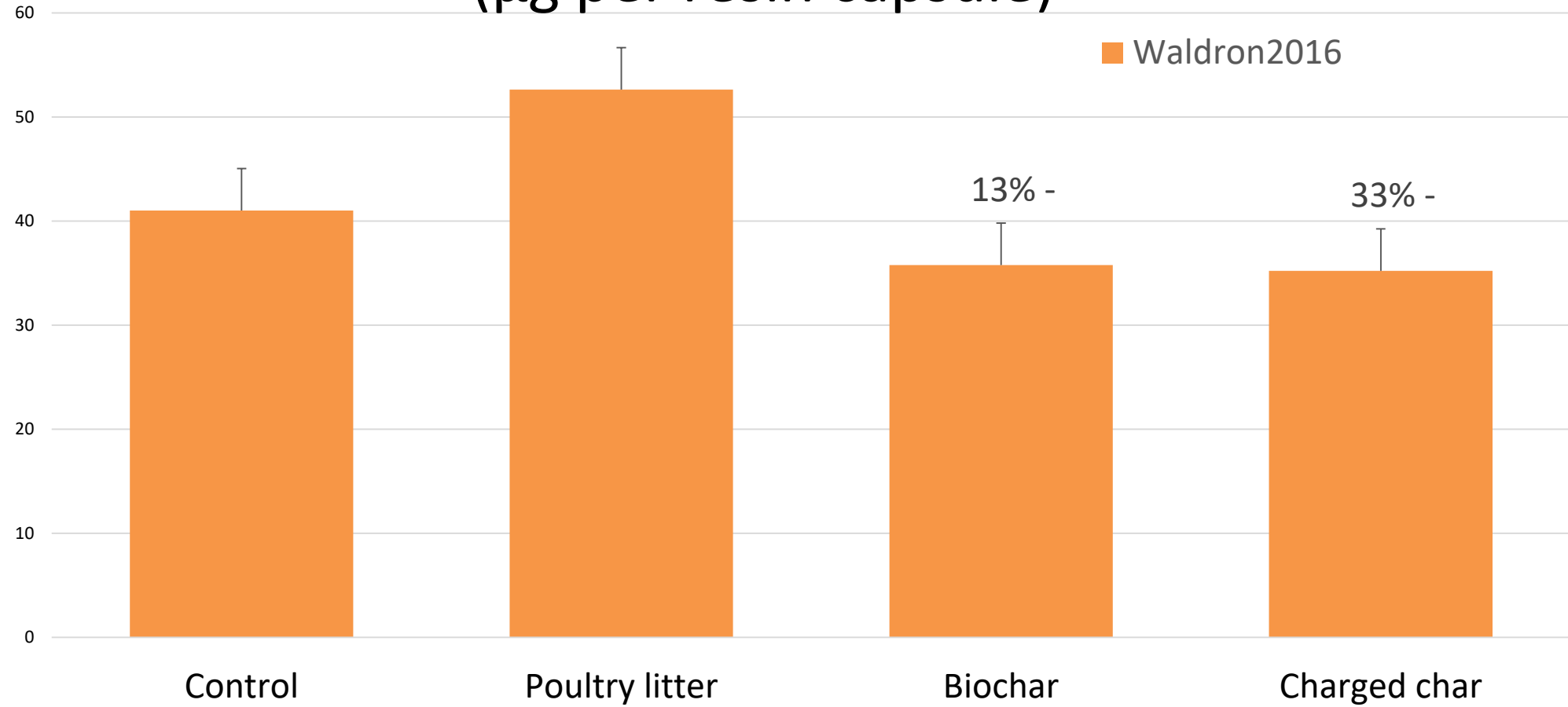
Soil soluble inorganic P* (mg kg⁻¹)



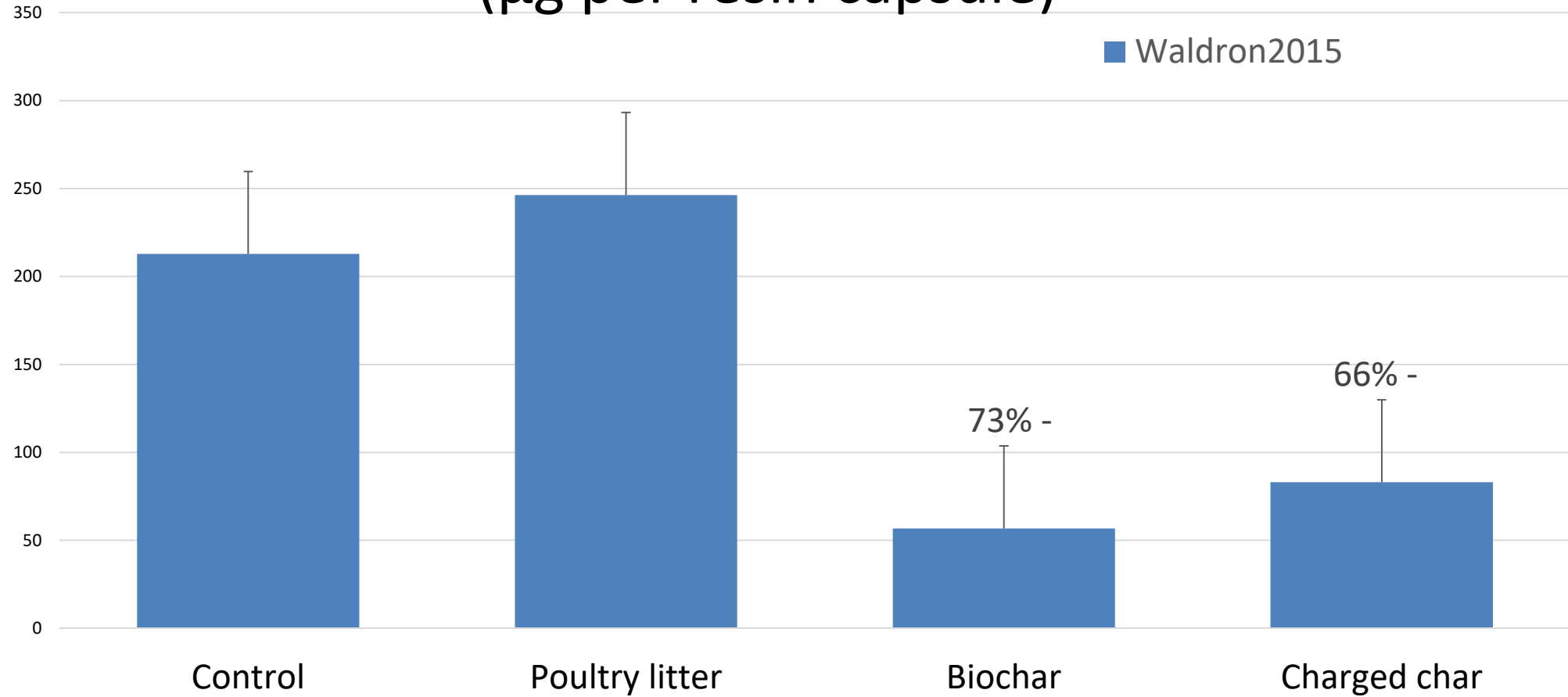
Soil water-hoding capacity



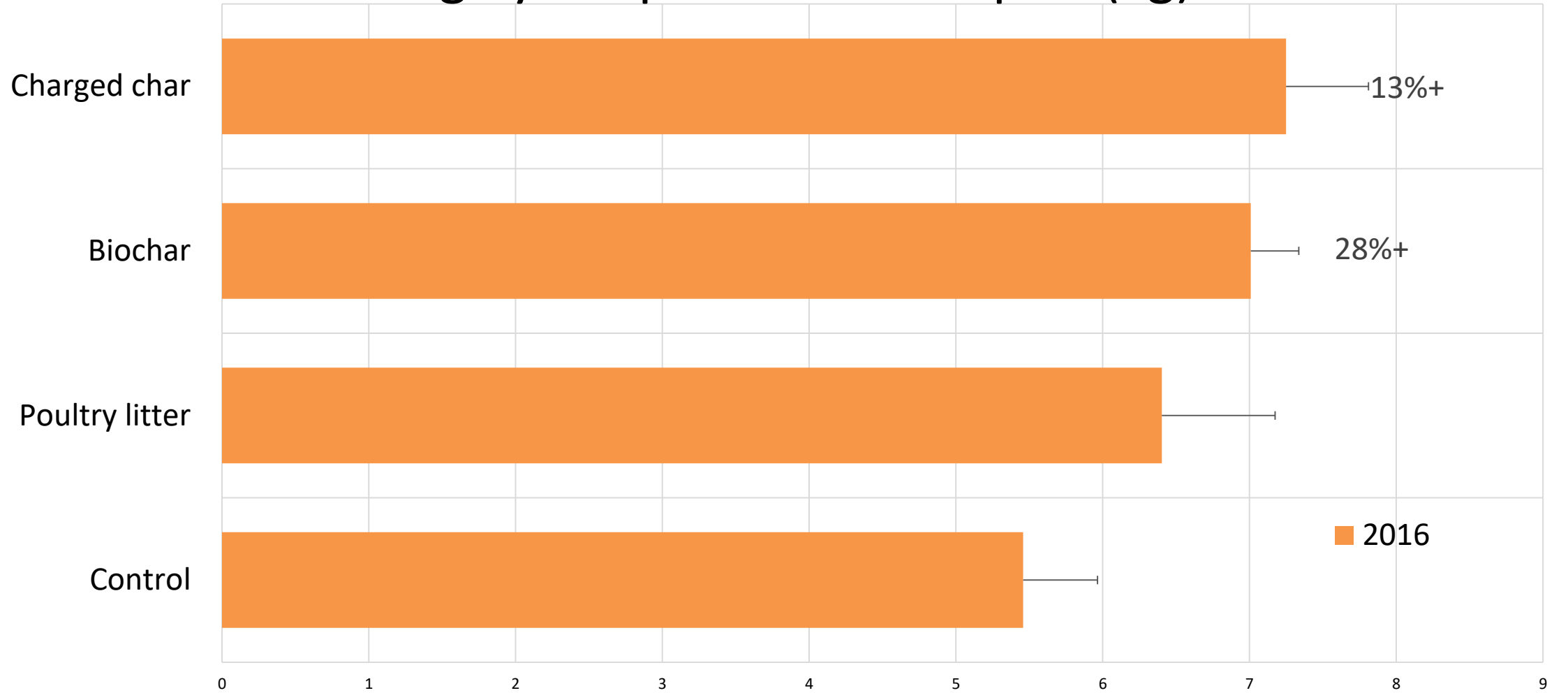
Accumulated NH_4^+ -N below rooting zone (μg per resin capsule)



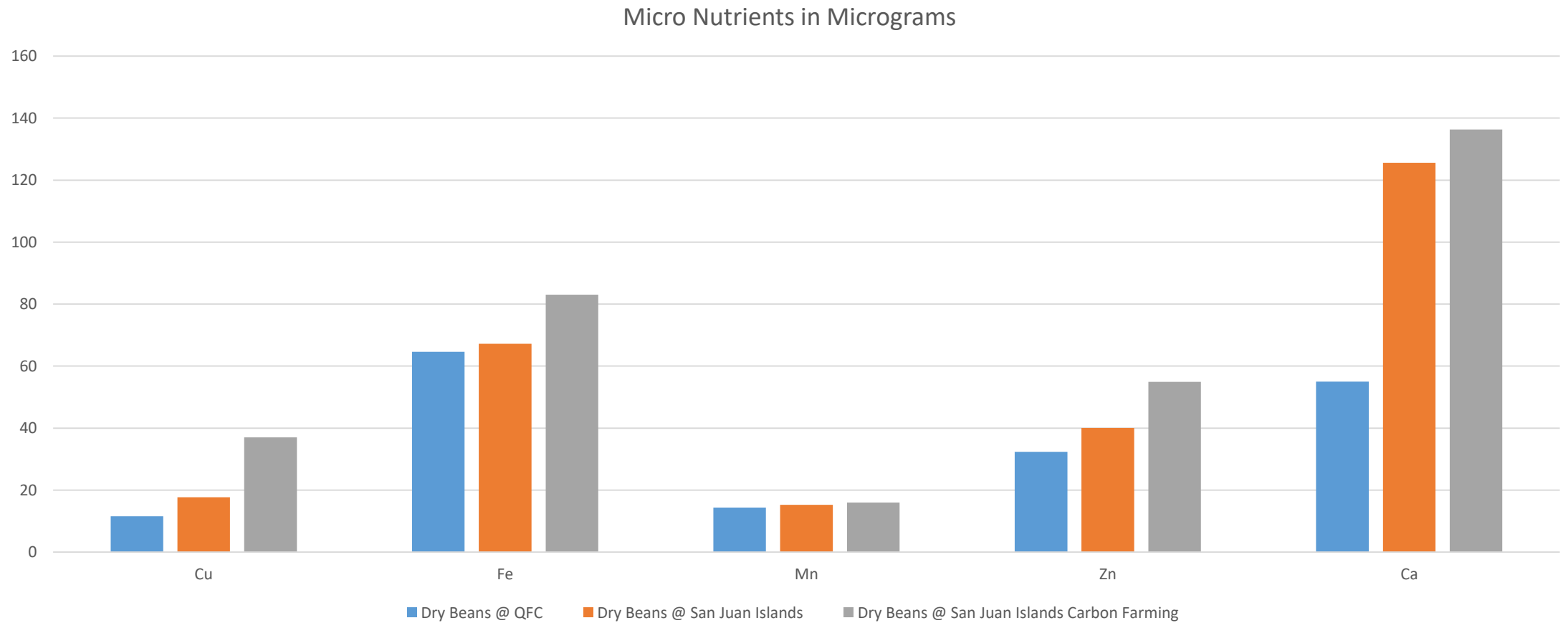
Accumulated NH_4^+ -N below rooting zone (μg per resin capsule)



Average yield per treatment plot (kg)



Nutrient Density in Dry Beans 2015



Creating a Market for Char

Restorechar: a cooperative
branding and marketing
program

CHARCOAL

STORE
CARBON
IN THE
SOIL
NOT THE
AIR



FOR MORE INFORMATION VISIT:
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