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Evaluating Pecan Orchard Soil Quality

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Why should you focus on improving orchard soil health?

- Soil health is the key to reducing fertilizer inputs
- Healthy Soils:
 - Efficient use of nutrients
 - Minimize water loss
 - Optimize yield and quality



Native Pecan Soils

- Pecans are native to alluvial soils of the Mississippi River Valley drainage system, Texas, Oklahoma and Mexico
 - Drain rapidly after flooding
 - Receive additional deposits of sediment and debris (organic matter) after flooding
 - Very deep & fertile



George Ray McEachern

Non-Native Soils (SE Coastal Plain Soils)

- Upland Soils
 - Acidic
 - Generally deficient in N, P, K, S, Ca, Mg, Zn
 - Respond well to addition of fertilizer and organic matter
 - Deep, sandy loam topsoil; permeable clay subsoil
 - Ruston, Norfolk, Tifton, **Orangeburg**, **Greenville**, Red Bay, Cecil (Skinner et al., 1938)



What Does a Healthy Soil Look Like?

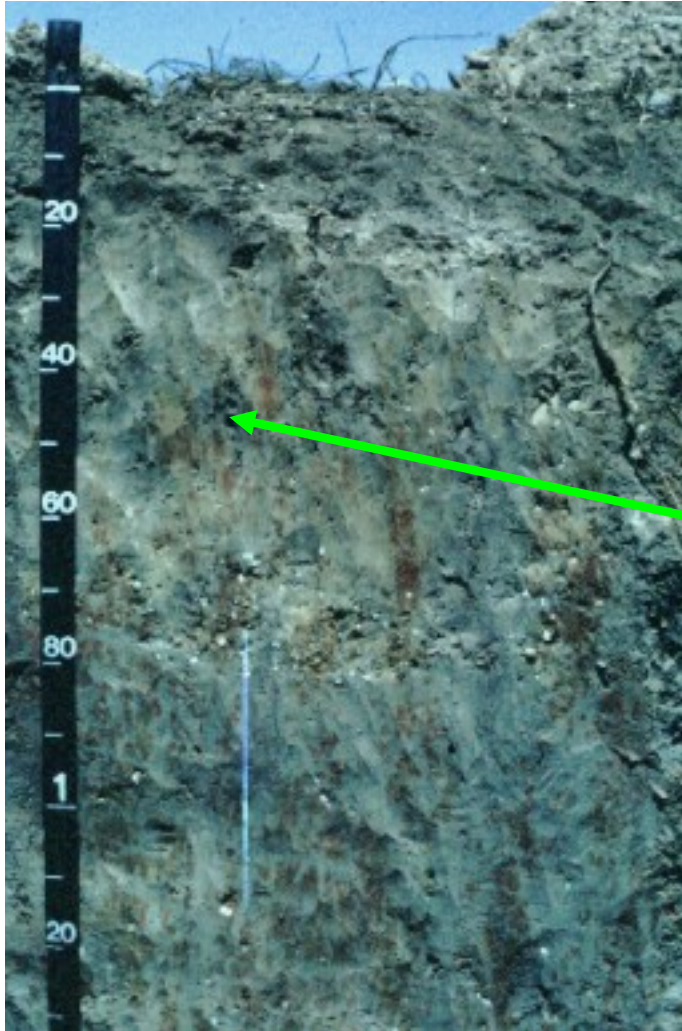


Dark brown to black surface layer
High in organic matter
Well aggregated

Feeder Roots grow to considerable depths

Orangeburg Soil Profile

What does poor soil look like?



Light tan-gray soil indicates low organic matter

Blue/gray/greenish mottling indicates
Poor aeration and water-logging

Where are my feeder roots?



Organic Matter

- Pecan orchards are relatively high in organic matter
- Most organic matter will be at a shallow depth in the soil
- Fertilizers are most effective when soil organic matter is maintained at a high level
 - Availability of nutrients
 - C:N ratio
 - Water-Holding Capacity

	Orchard Soil Organic Matter (6" depth)
Mean	3.63%
Sample Range	1.74-5.80%

Average forest soil organic matter in Georgia Coastal Plain = 2.52% (Giddens, 1957)

Soil Carbon

- C:N ratio
 - Determines the rate at which N is mobilized or immobilized in the soil
 - Optimal Range (15:1-20:1)
 - <12:1 –stimulates decomposition of OM
 - Clover: (15:1)
 - Poultry Litter (10:1-25:1)
 - Grass: (40:1-80:1)

	C:N ratio (6" depth)
Mean	13:1
Sample Range	12:1-16:1

Hypothesis & Objectives

- Soil quality improves when land is converted to pecan orchard production
- The objectives of this study were to analyze and compare soil quality indicators of pecan orchards of varying ages and adjacent row crop fields to quantify soil enhancement over time.



Selection of Soil Quality Indicators



- Require indicators that are sensitive to changes in land use & management practices.

Bio./Chem./Phys. Property

-Organic Matter

Biological Properties

-Active Carbon

-Solvita CO₂ Burst

-Solvita Labile Amino Nitrogen (SLAN)

Chemical Properties

-Soil pH

-CEC

-Total N (%)

Physical Properties

-Aggregate Stability

-Bulk Density

-Porosity



Sampling Method 2020 & 2021

- Orchards separated into age groups of 1-4 yr., 5-10 yr., 11-20 yr., and >20 yr.
- Samples were taken at a depth of 6 inches. (15 cm)

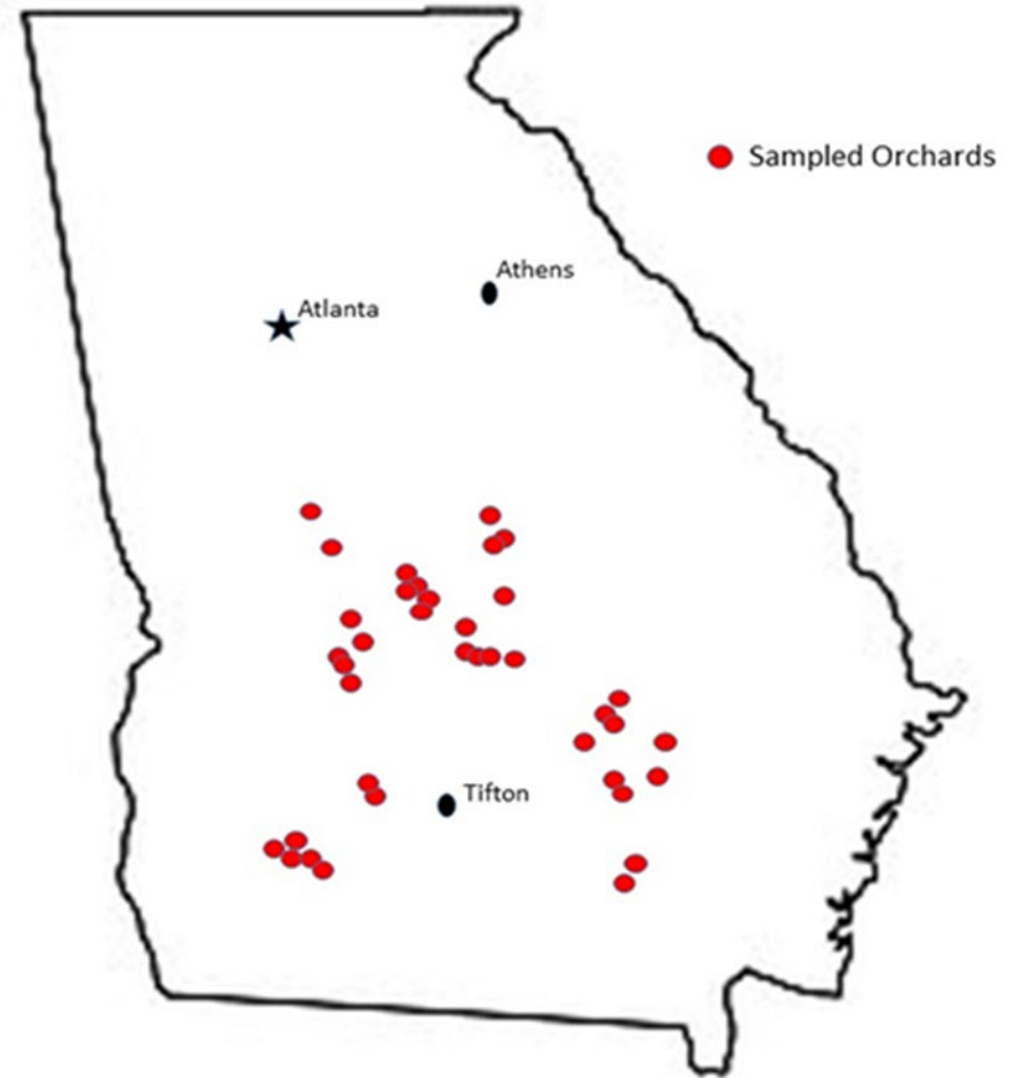
(Additional sample taken at 36" in 2021)

- Four composites were collected at random from each orchard and row crop field.
- Samples analyzed by Water's Agricultural Laboratories, inc. in Camilla, GA.



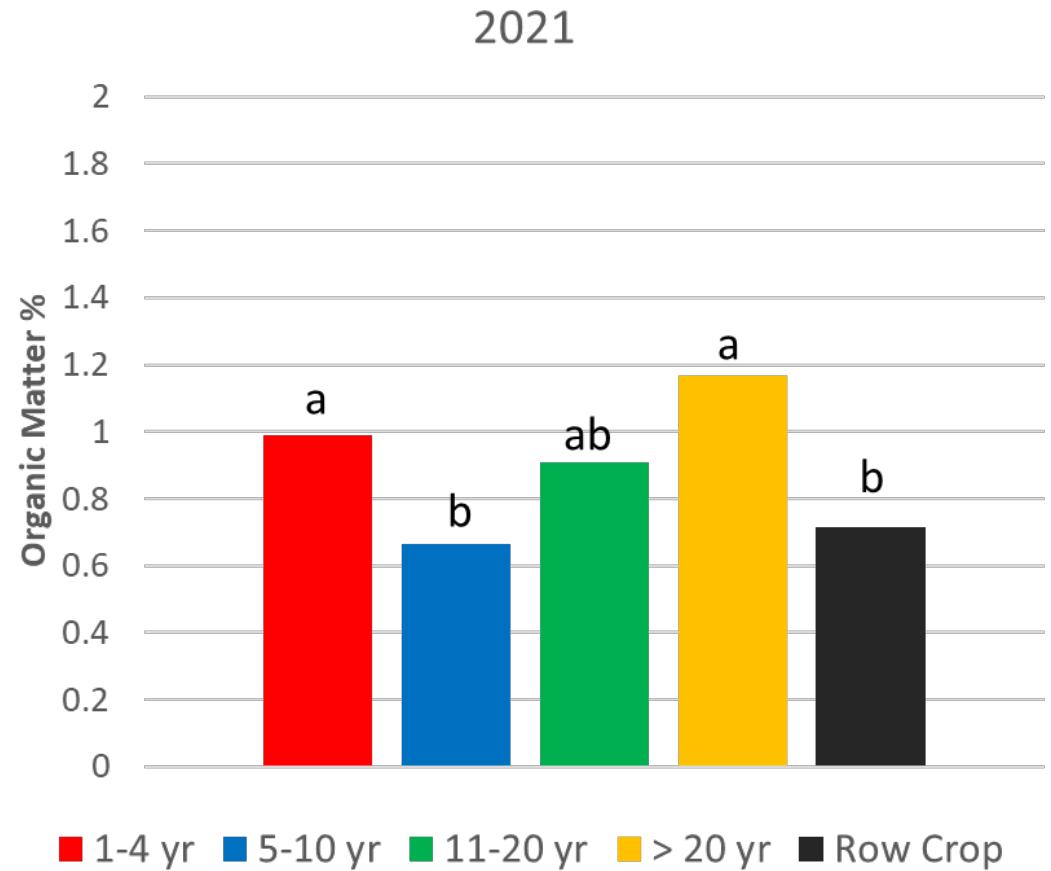
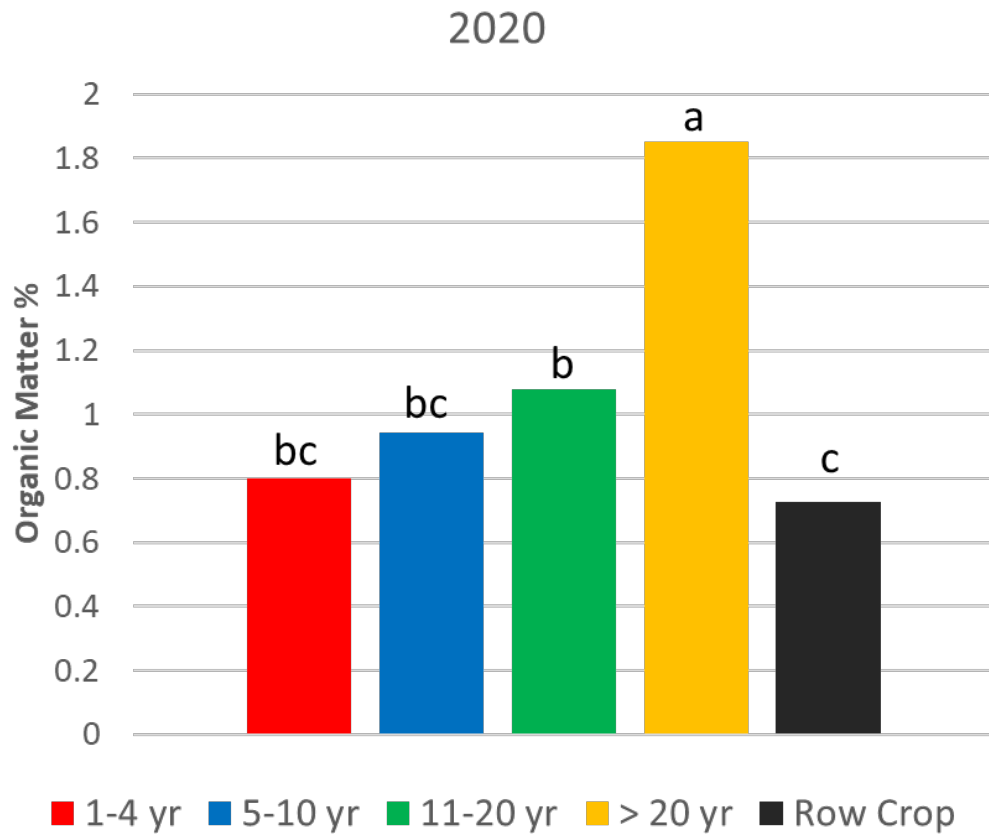
Sampled Area

- Sampled 41 different commercial orchards along with 41 corresponding row crop fields.
- Total of 512 soil samples collected.

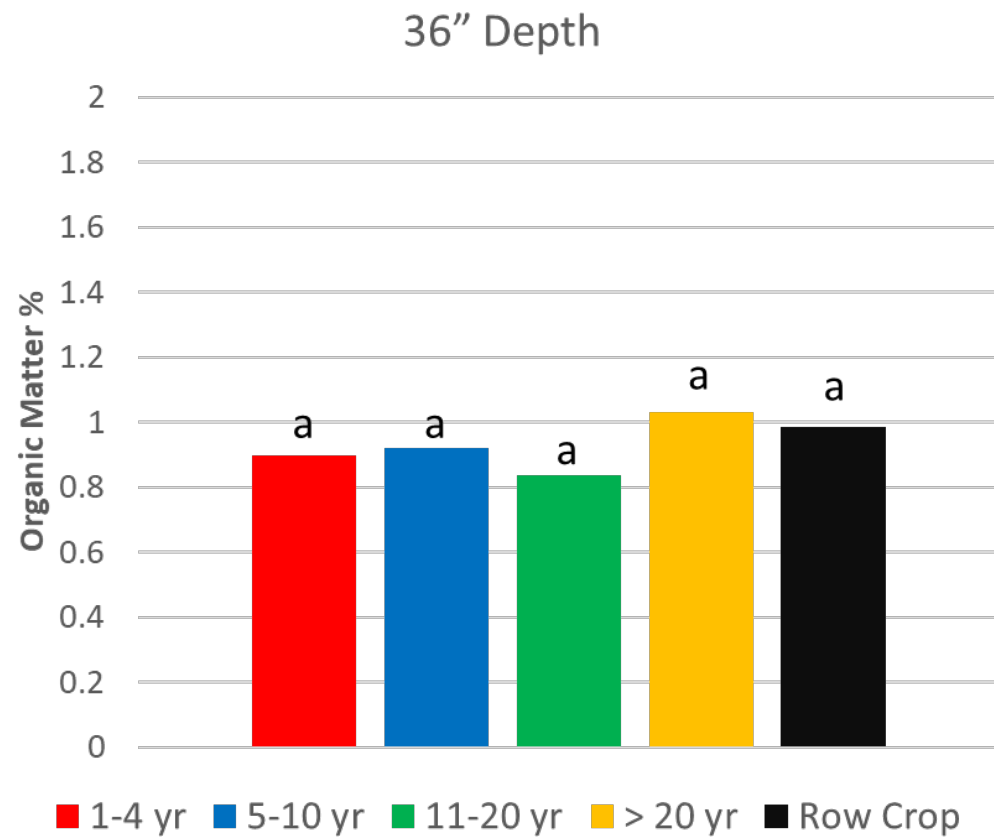


Results

Organic Matter

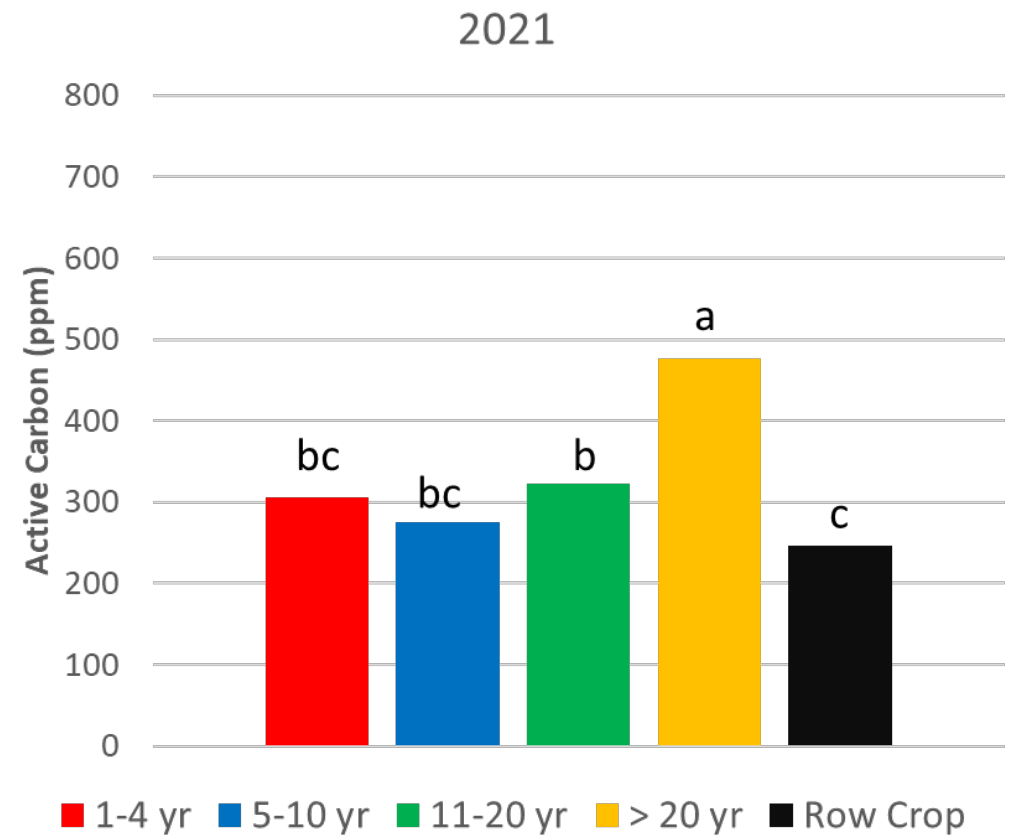
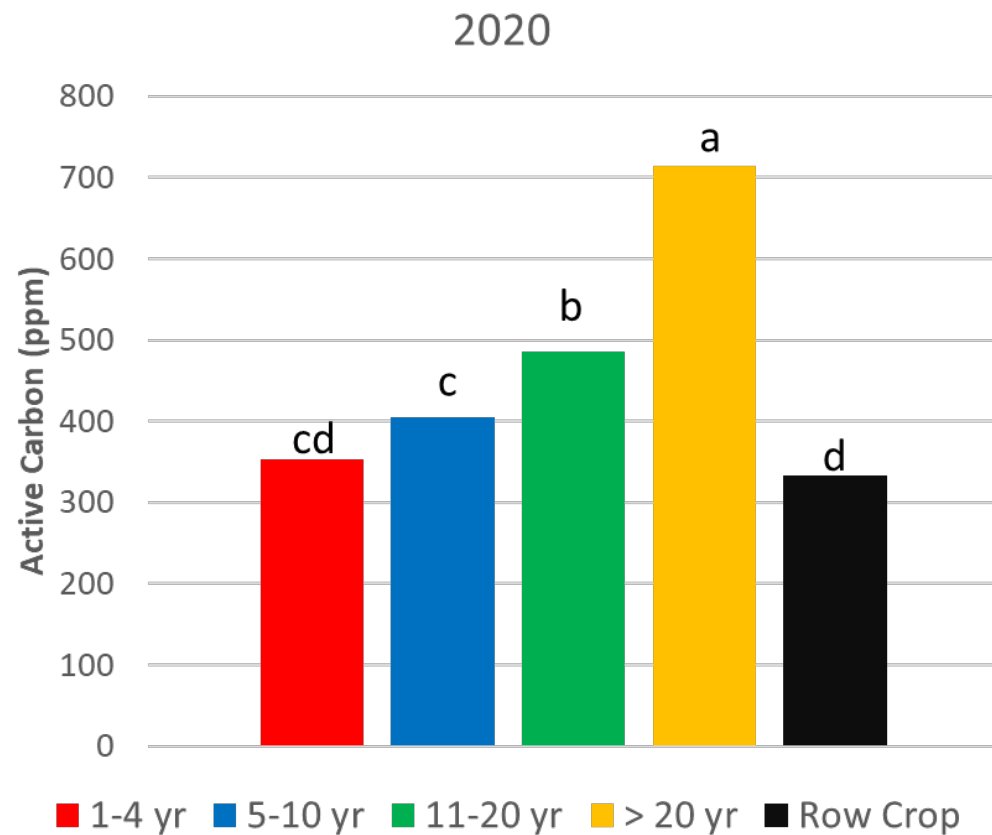


Organic Matter

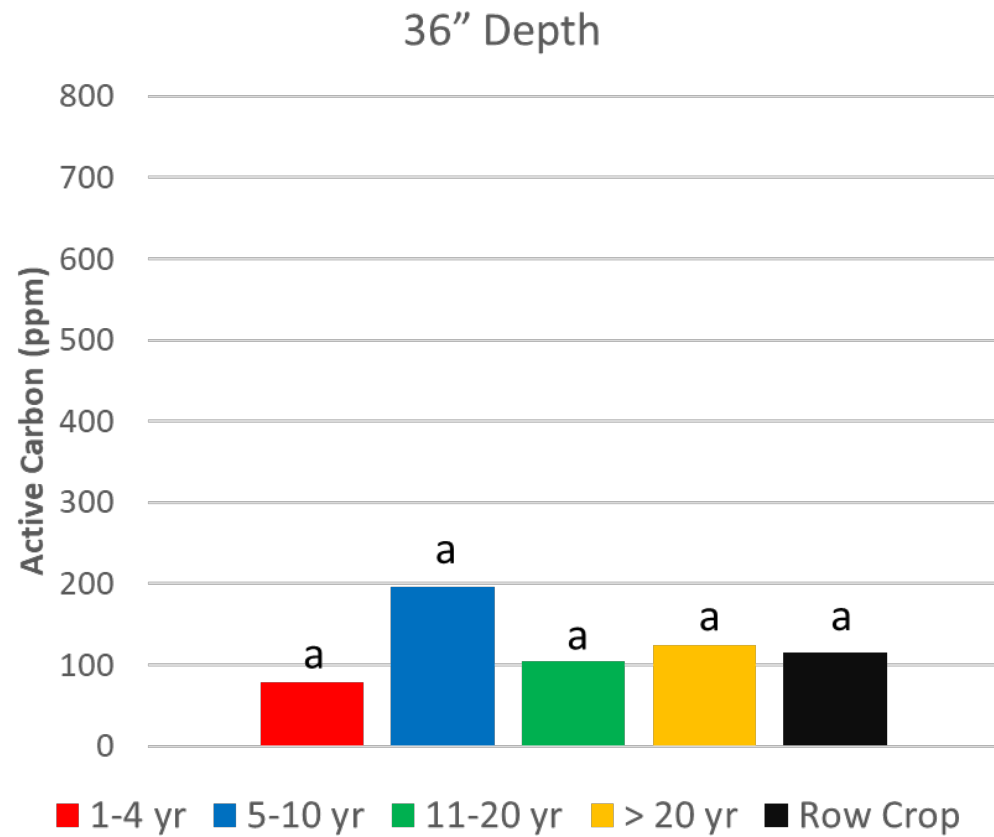


Biological Properties:

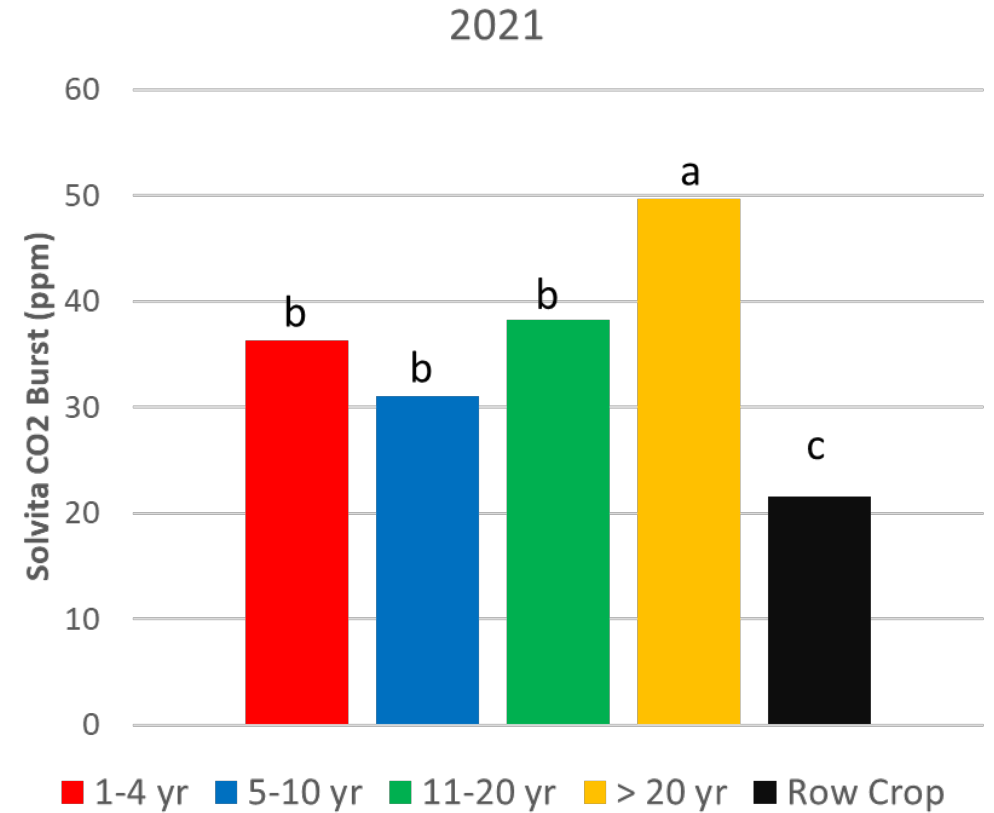
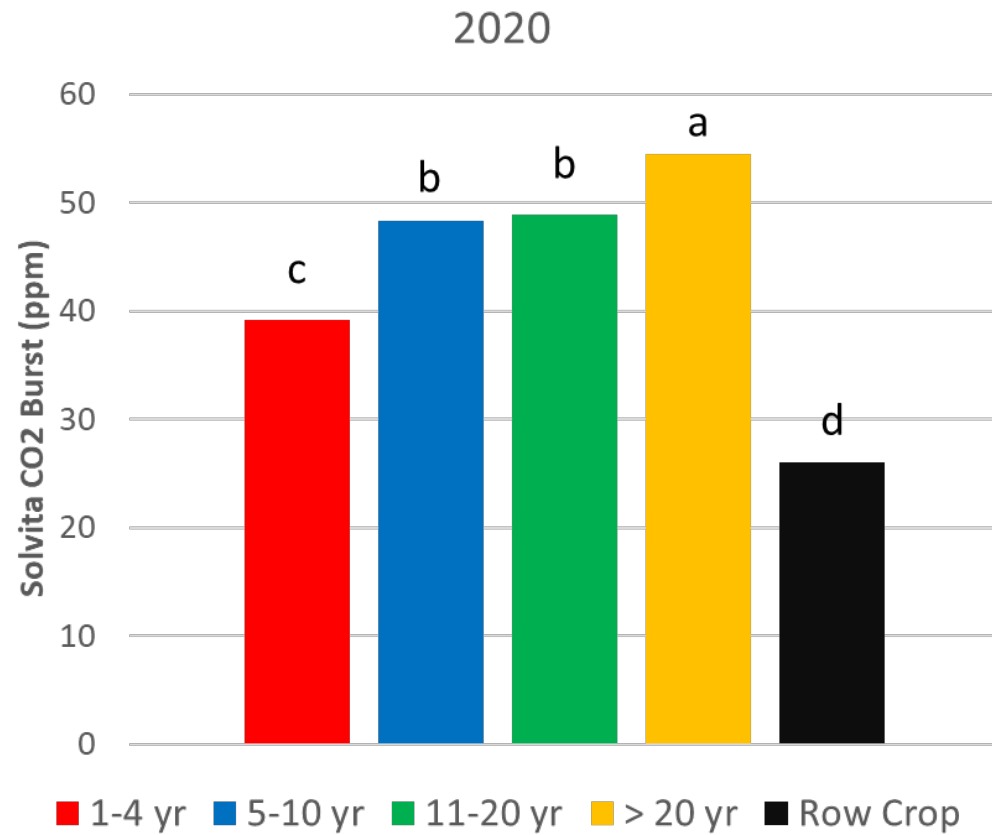
Active Carbon



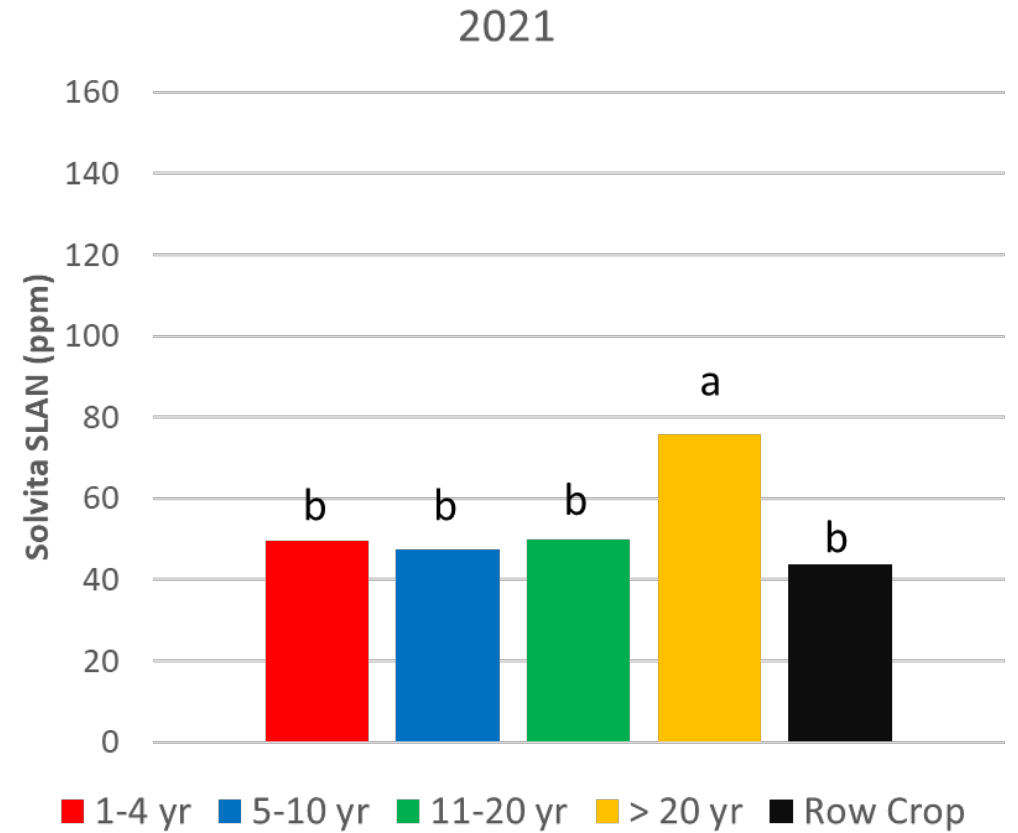
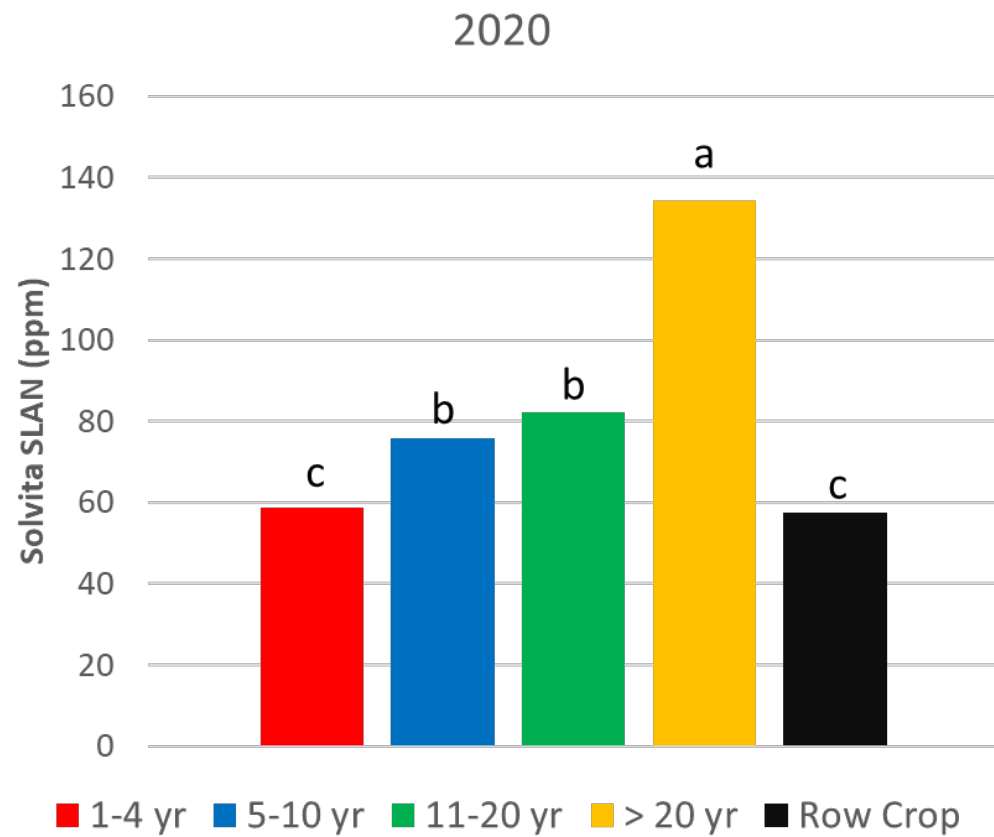
Active Carbon



CO₂ Burst

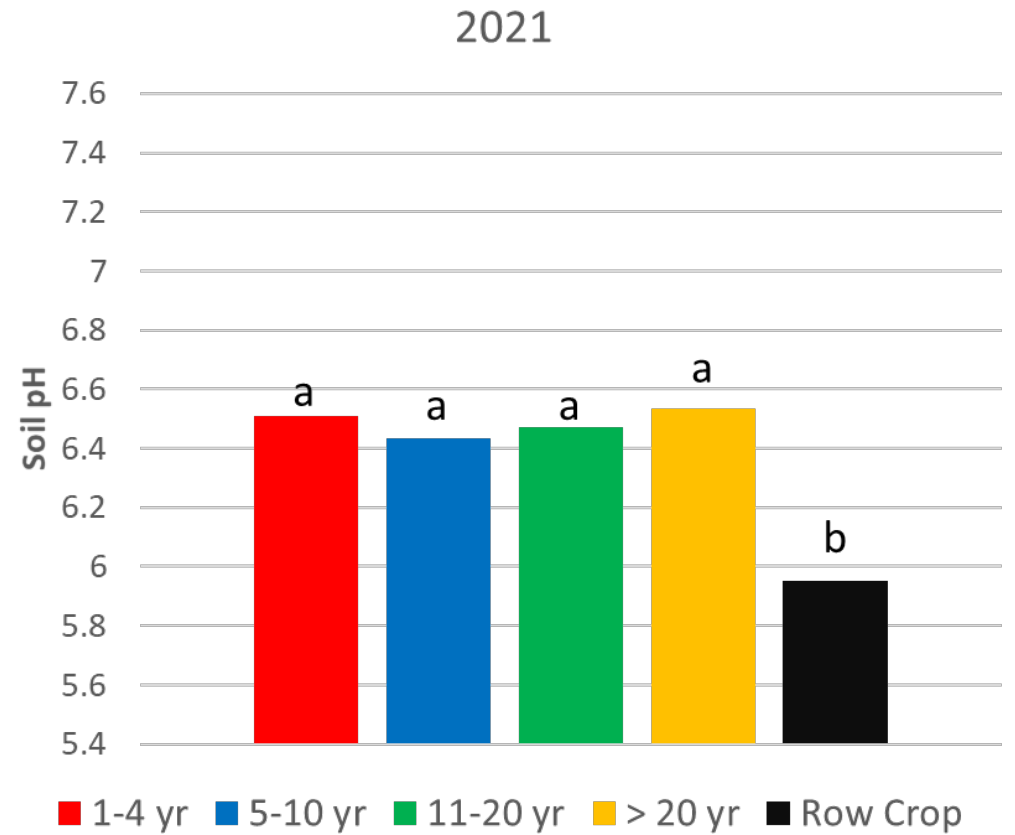
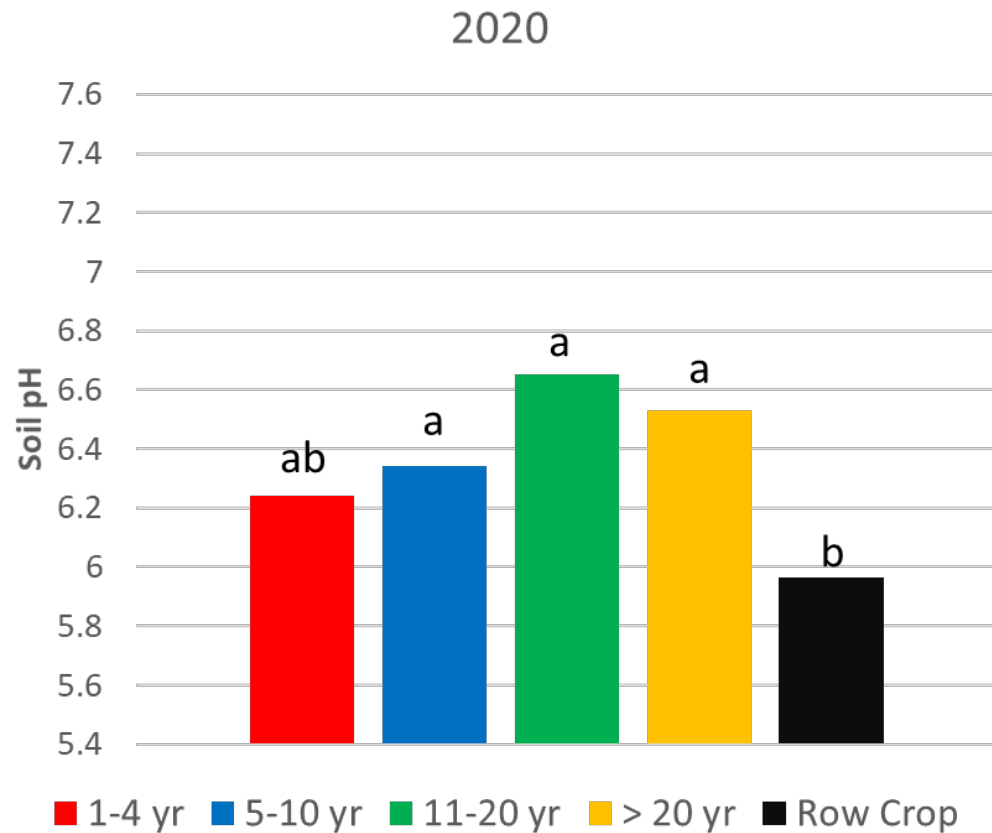


SLAN

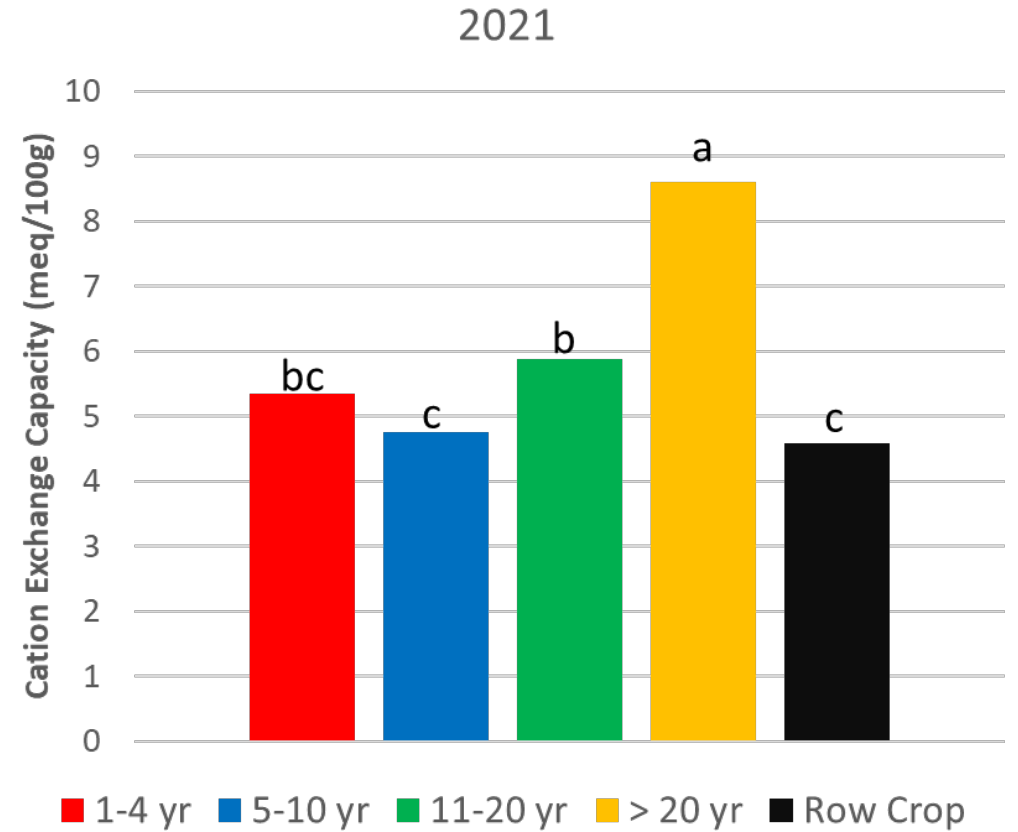
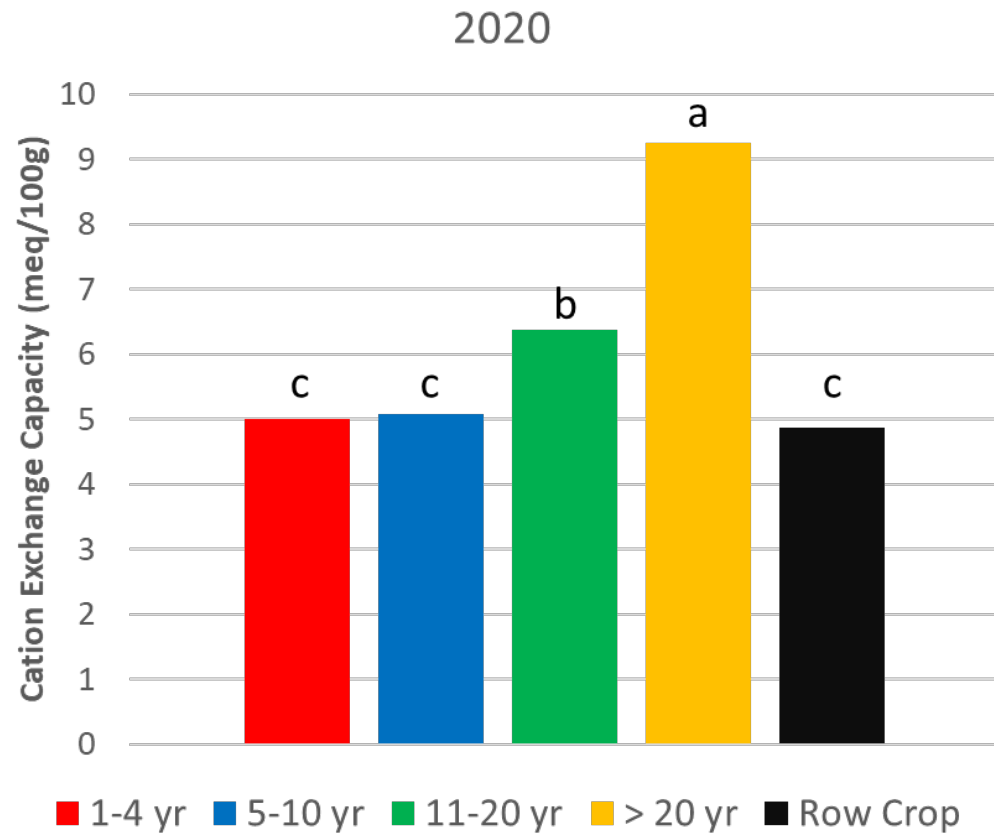


Chemical Properties:

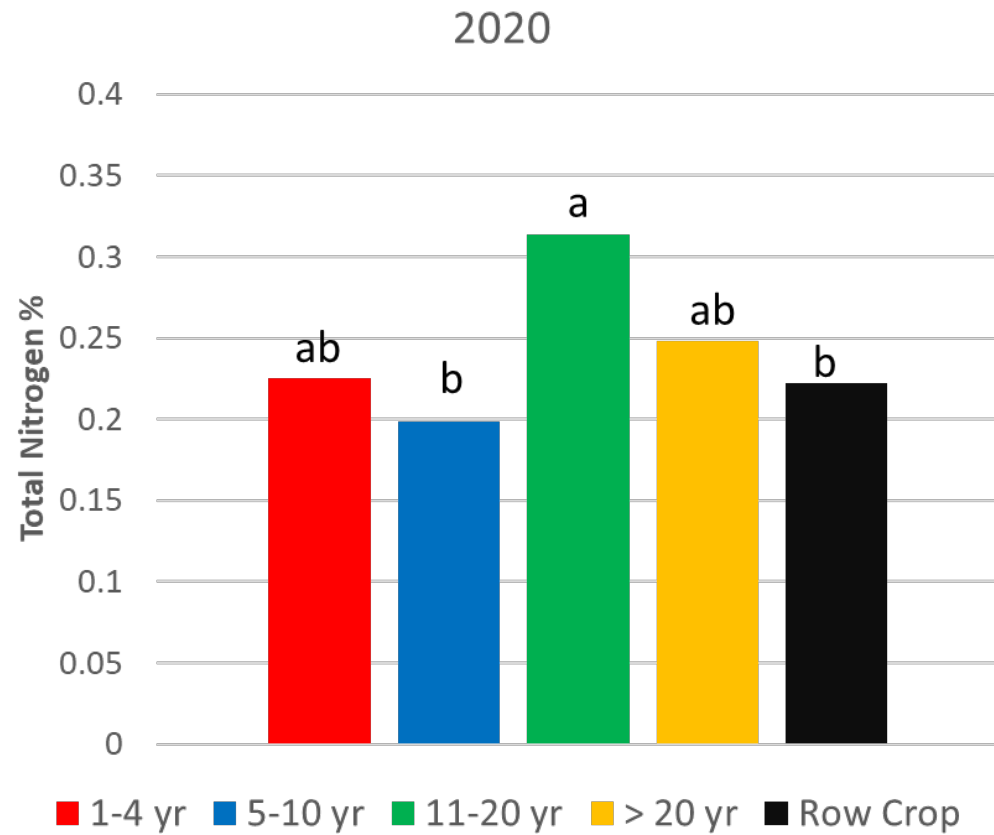
Soil pH



Cation Exchange Capacity

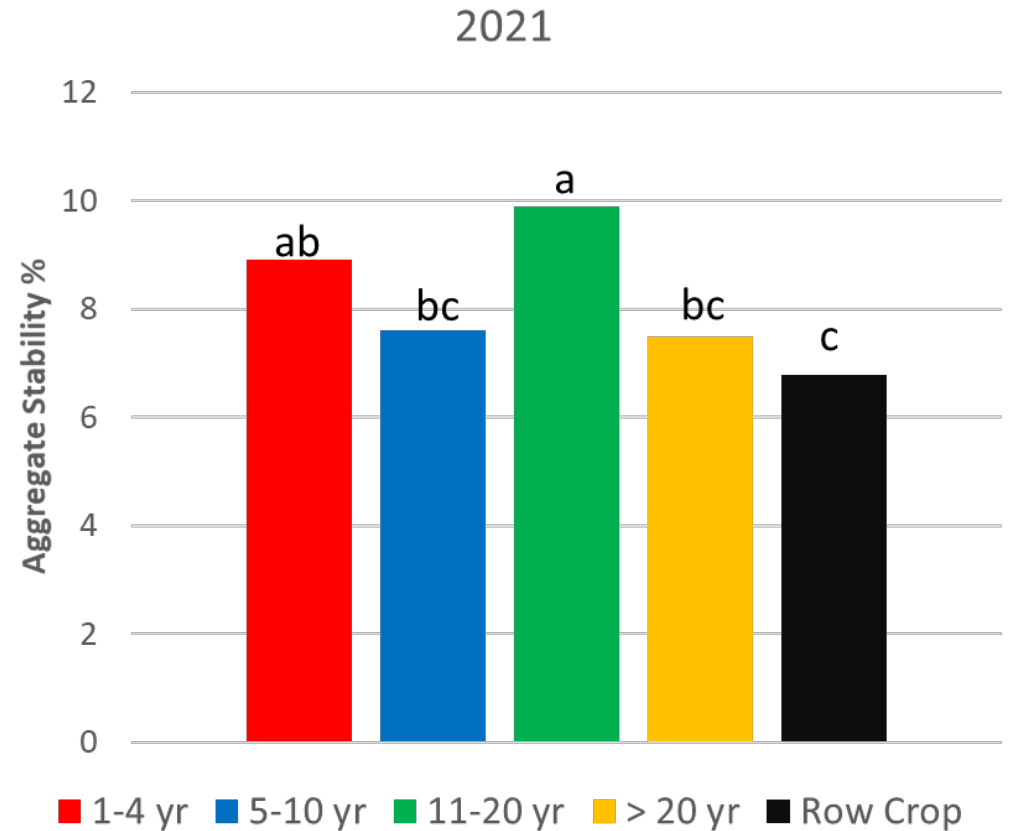
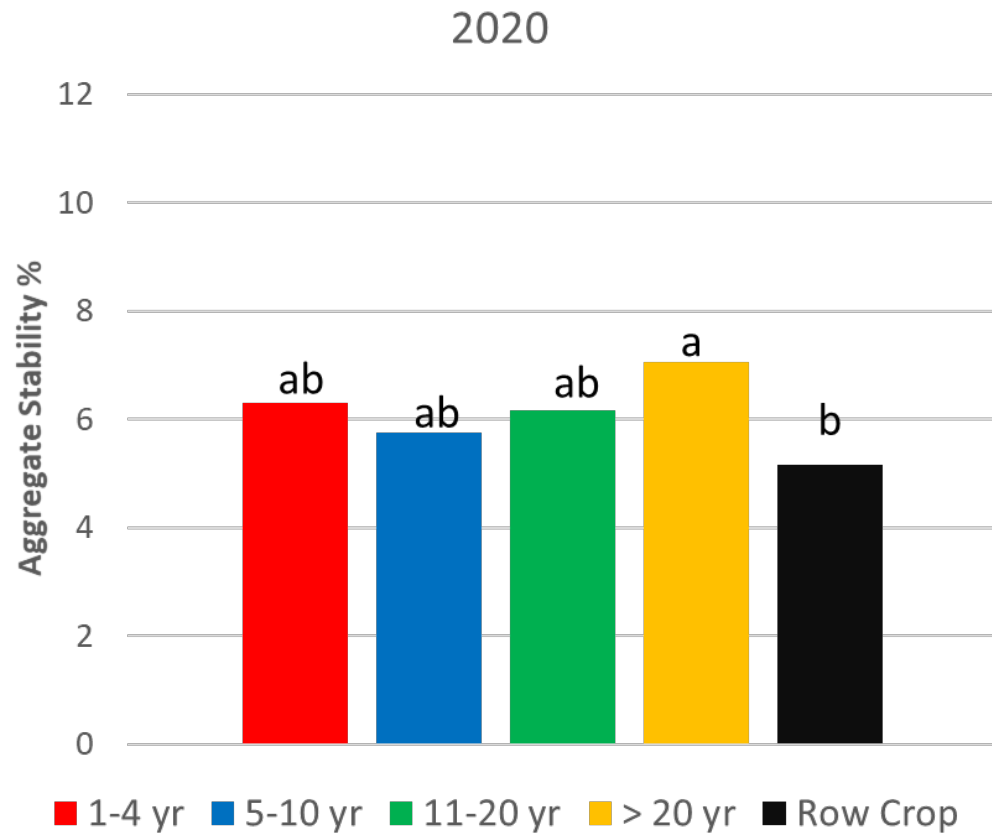


Total Nitrogen

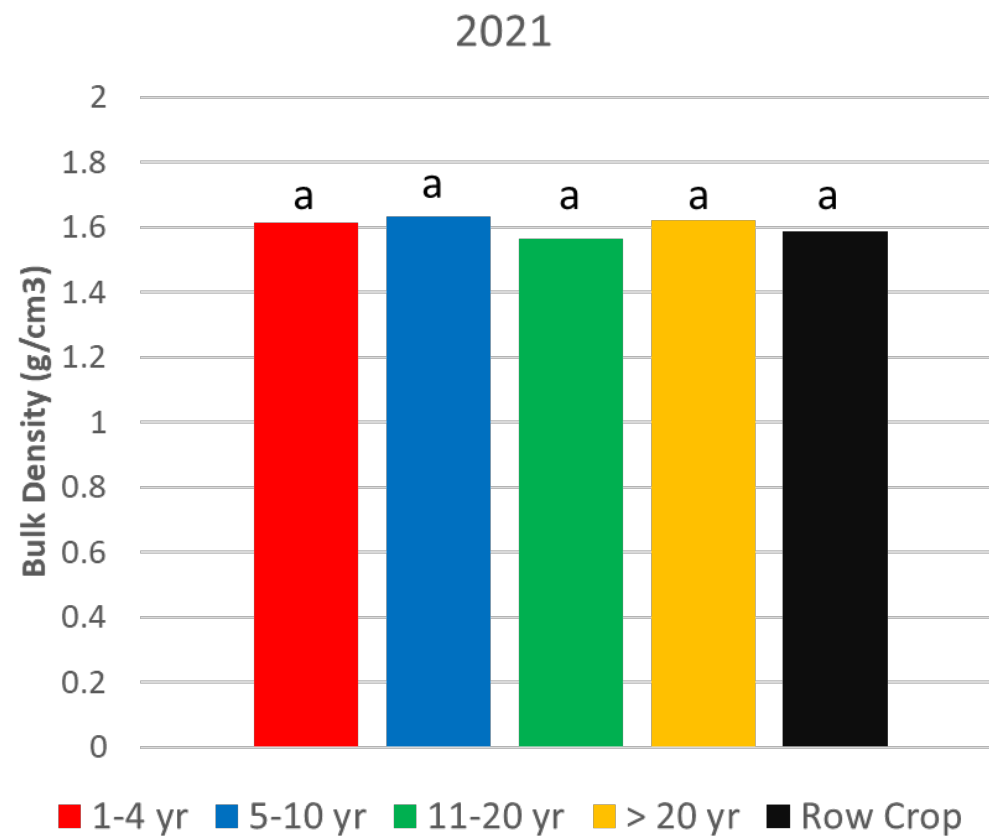
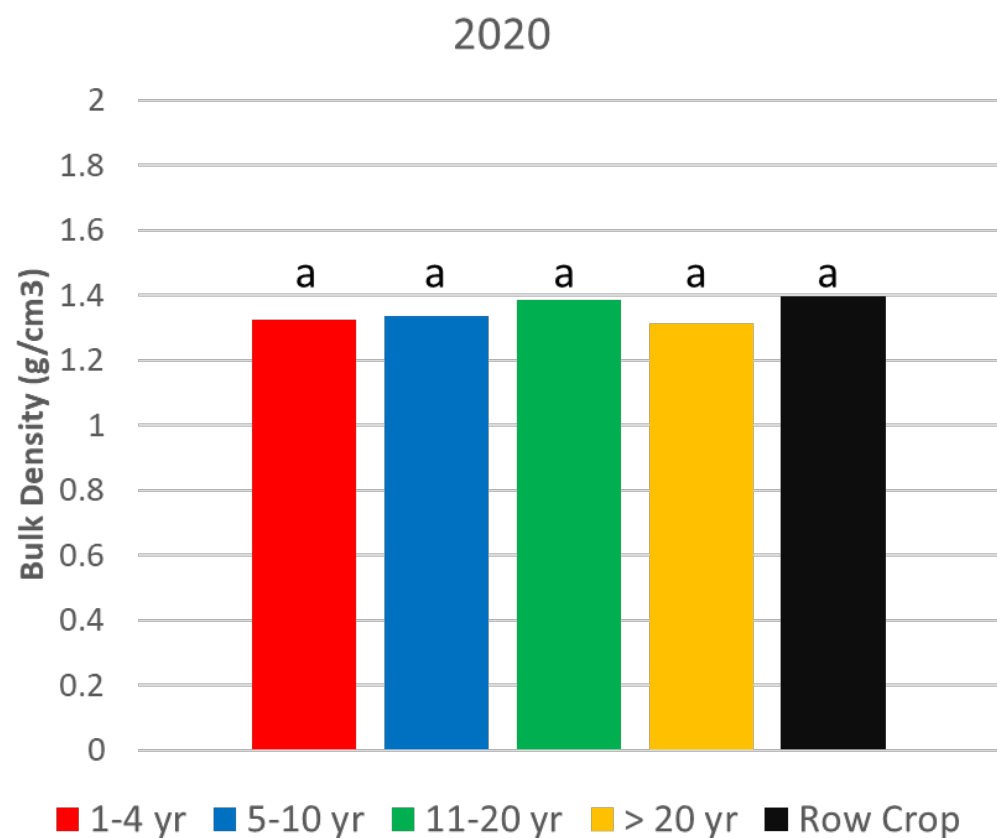


Physical Properties:

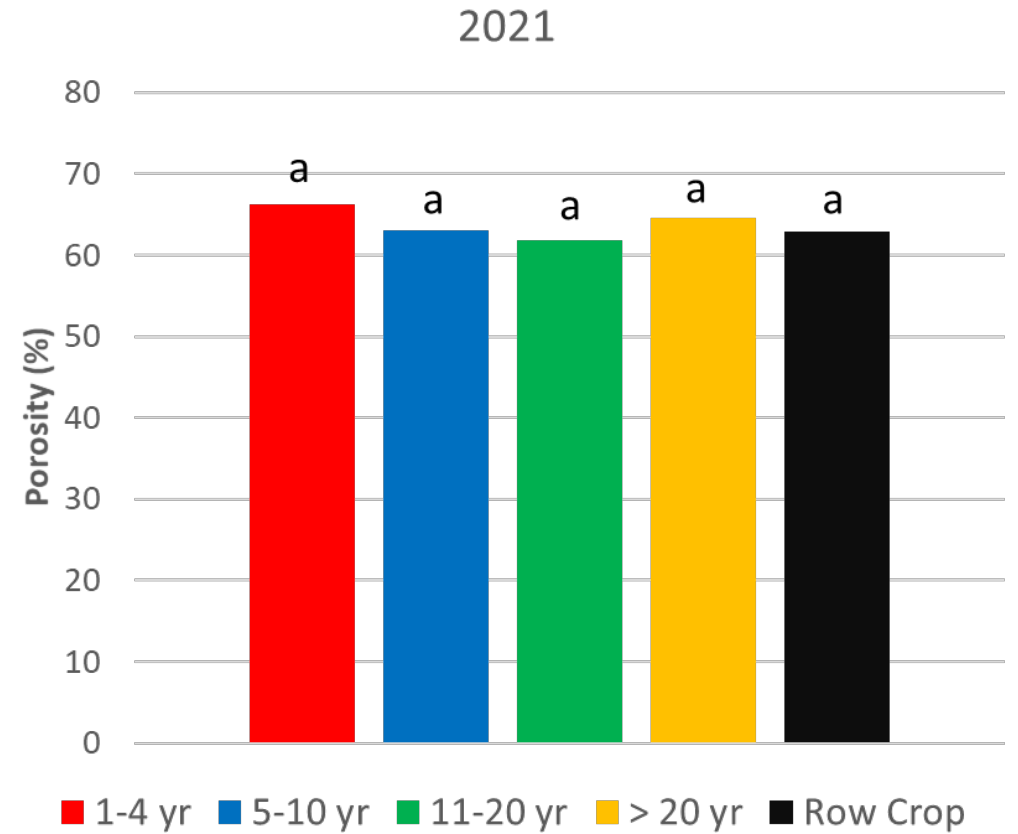
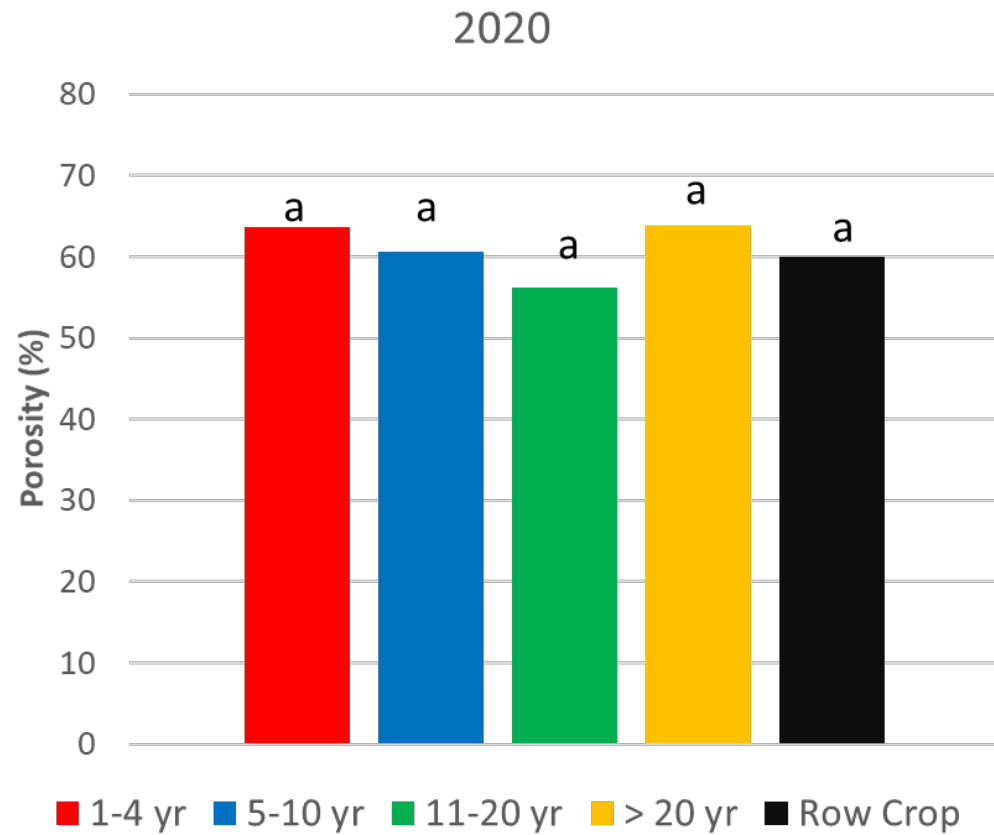
Aggregate Stability



Bulk Density (g/cm³)



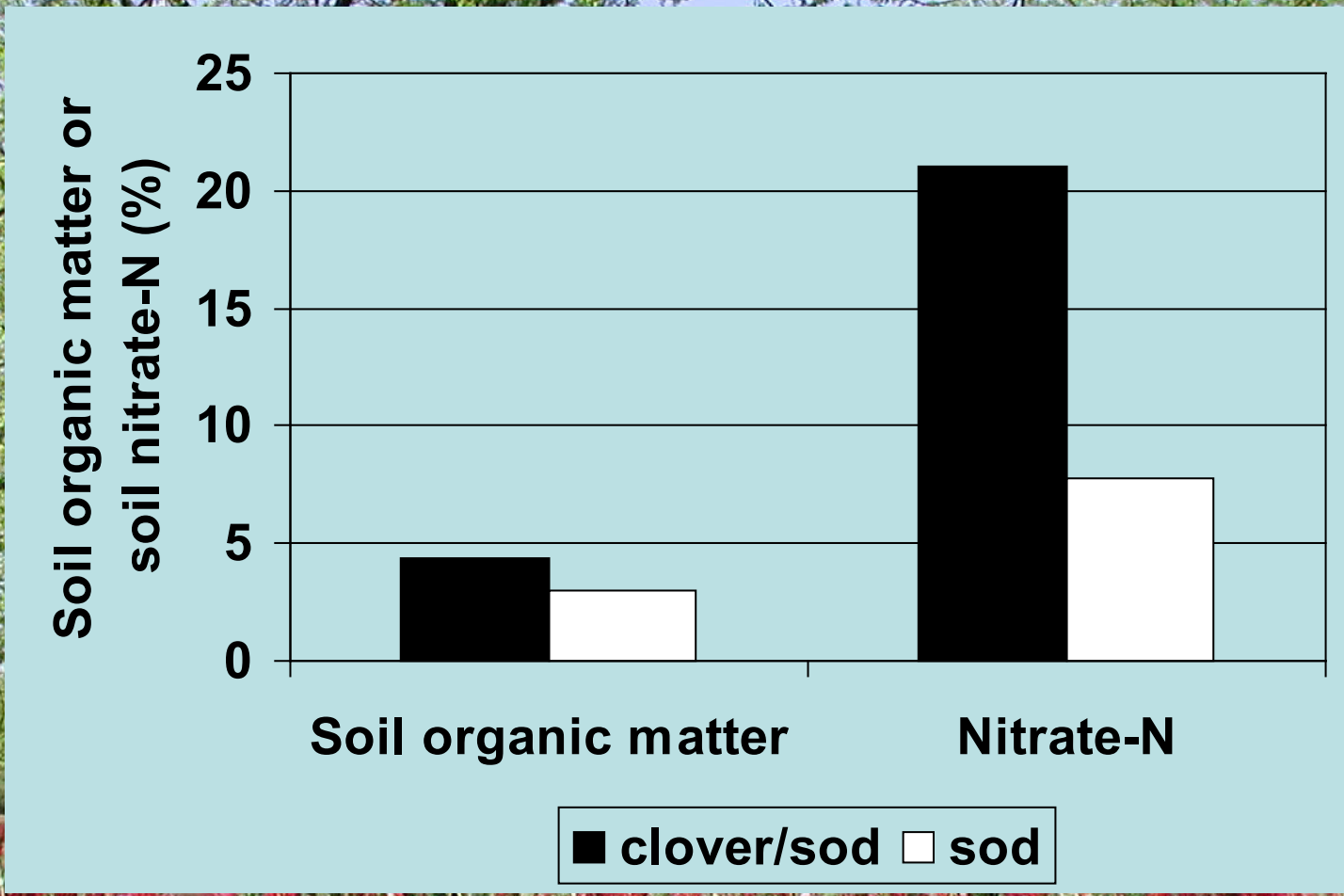
Porosity



Summary

- Soil data indicates soil health and soil fertility is significantly enhanced over time in pecan orchards vs. row crop fields.
- Soils more biologically active in pecan orchards than conventional row crop fields.
- Physical properties show very little change in overall soil structure.
 - Uniformity of soil type throughout the sampled region.
 - Sandier soils exhibit much poorer structural qualities.
- Data indicates that soil quality does improve over time in pecan orchards in the SE region.
- Not much variation at deeper soil depths





Crimson Clover:
70-130 lbs N
3500-5500 lbs dry matter/A

White Clover:
80-200 lbs N
2,000-6,000 lbs dry matter

Enhancing Organic Matter

- In-Orchard Recycling of Debris:
 - Boosts soil organic C
 - Enhances soil nutrition
 - Increased moisture holding capacity
- Potential Issues:
 - Micro-organisms breaking down material use N from soil if they don't get enough from material
 - Will chips interfere with harvest/cleaning?
- Chipping had little effect on plant-available soil N, P, or K and therefore poses no significant N, P, or K immobilization risk in New Mexico
- High biological activity in our environment will likely eliminate interference with harvest if pieces are small enough, but may use additional soil N



Flail Shredder



Questions

