Weed management with carbon additions: an example of applying the soil health framework for a goal other than yield.

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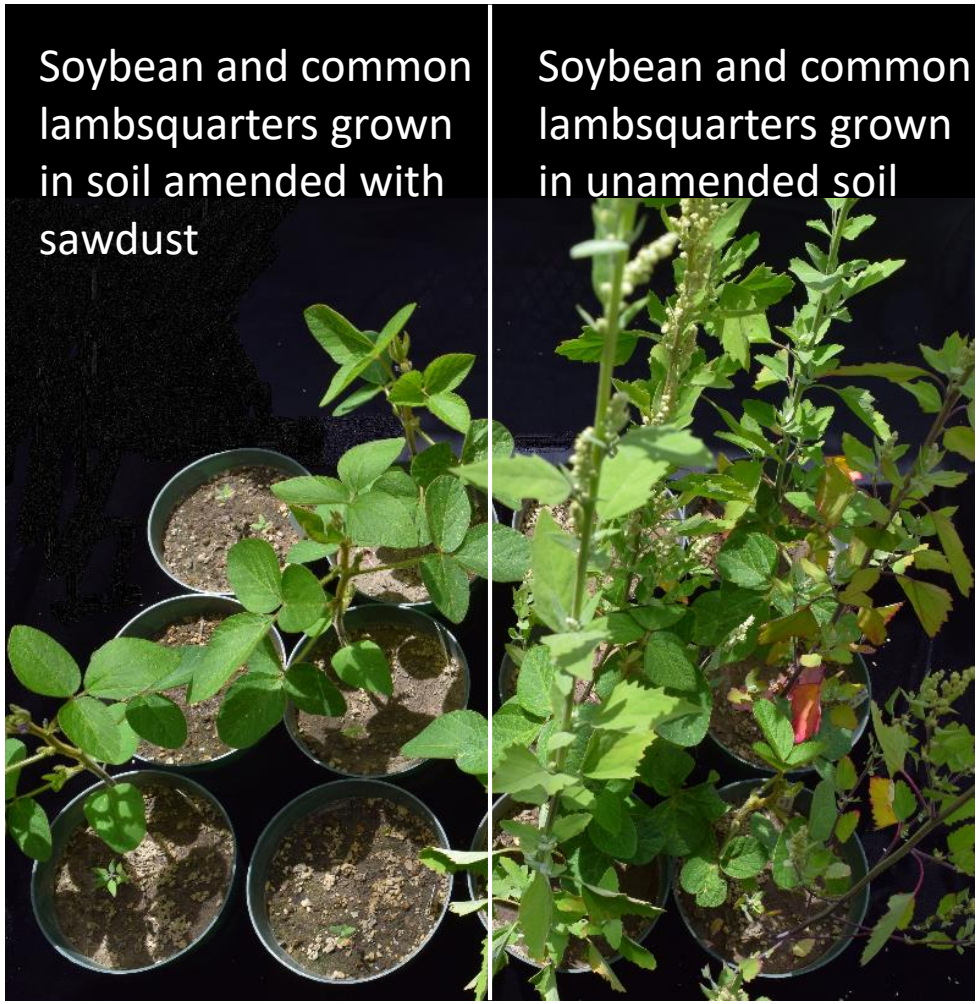
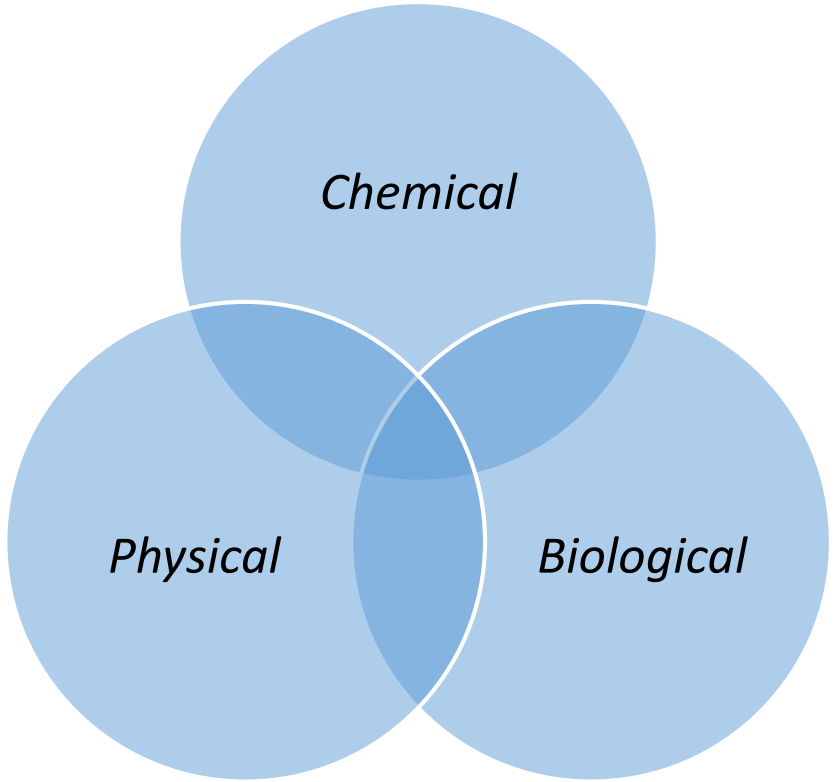


A healthy soil functions well by incorporating the chemical, physical, and biological components of the soil.



https://www.nrcs.usda.gov/wps/portal/nrcs/detail/national/soils/health

The primary goal of healthy soil is to improve farmer profitability in the long-term but other goals could also be considered.

Economic Effects of Soil Health Practices on Gary Swede Farm, LLC (2018)

Increases in Net Income

Increase in Income

ITEM	PER ACRE	ACRES	TOTAL
Yield Impact Due to Soil Health Practices	$71.95	600	$43,168
Total Increased Income			**$43,168**

Decrease in Cost

ITEM	PER ACRE	ACRES	TOTAL
Reduced Machinery Cost due to Reduced Tillage	$23.43	1,500	$35,152
Nutrient Savings due to Nutrient Mngmnt.	$40.65	600	$24,390
Value of Decreased Erosion due to Soil Health Practices	$2.25	1,500	$3,369
Total Decreased Cost			**$62,911**
Total Increased Net Income			$106,079
Total Acres in the Study Area			1,500
Per Acre Increased Net Income			$71

Decreases in Net Income

Decrease in Income

ITEM	PER ACRE	ACRES	TOTAL
None Identified			$0
Total Decreased Income			**$0**

Increase in Cost

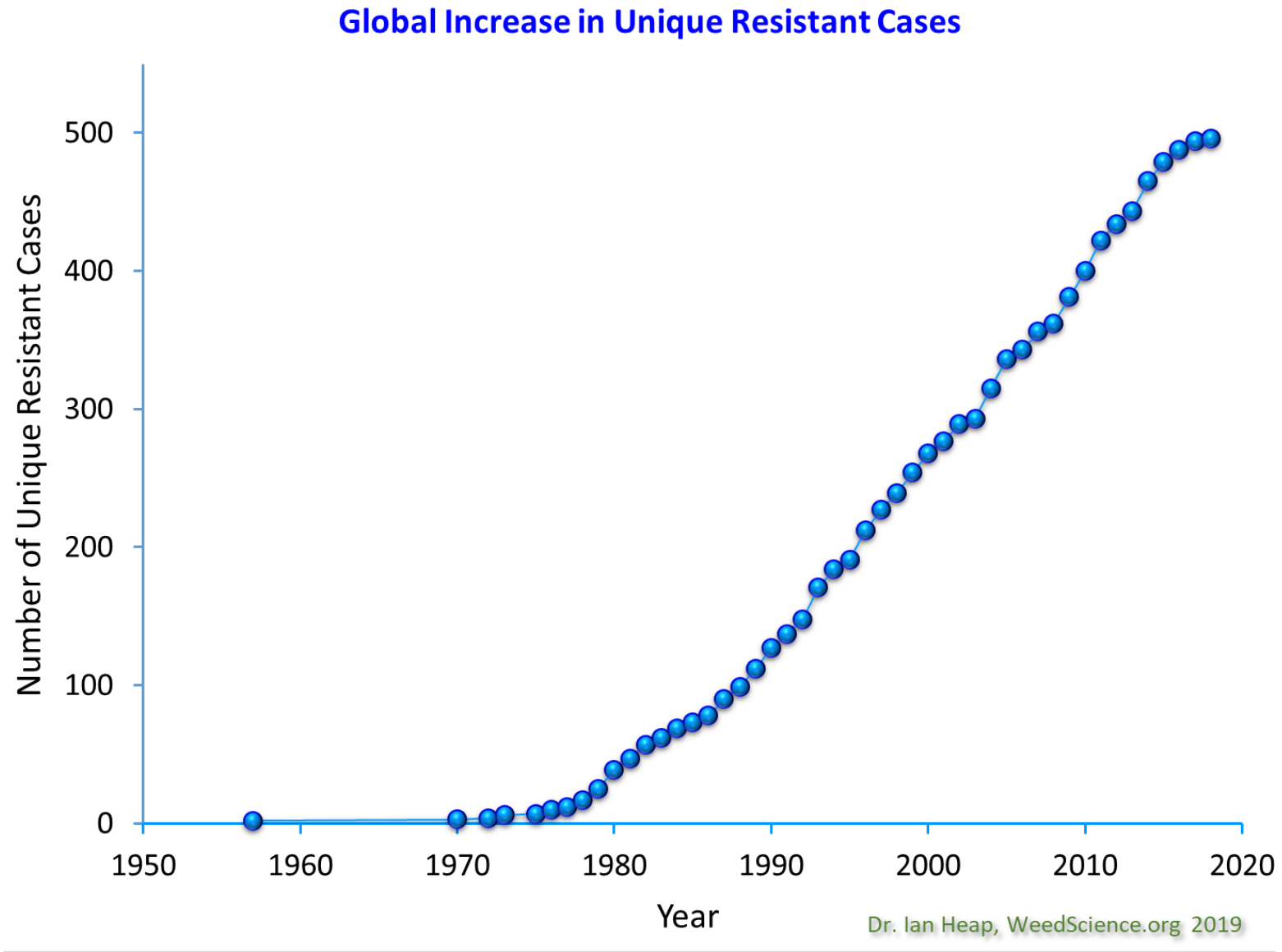
ITEM	PER ACRE	ACRES	TOTAL
Cost of Setting up Planter to Handle Residue	$0.72	600	$432
Cover Crop Costs	$51.00	450	$22,950
Residue and Tillage Mgmt. Learning Activities	$0.07	1,500	$98
Cover Crops Learning Activities	$0.22	450	$98
Nutrient Management Learning Activities	$0.16	1,500	$244
Total Increased Cost			**$23,822**
Annual Total Decreased Net Income			$23,822
Total Acres in this Study Area			1,500
Annual Per Acre Decreased Net Income			$16

Annual Change in Total Net Income = $82,257

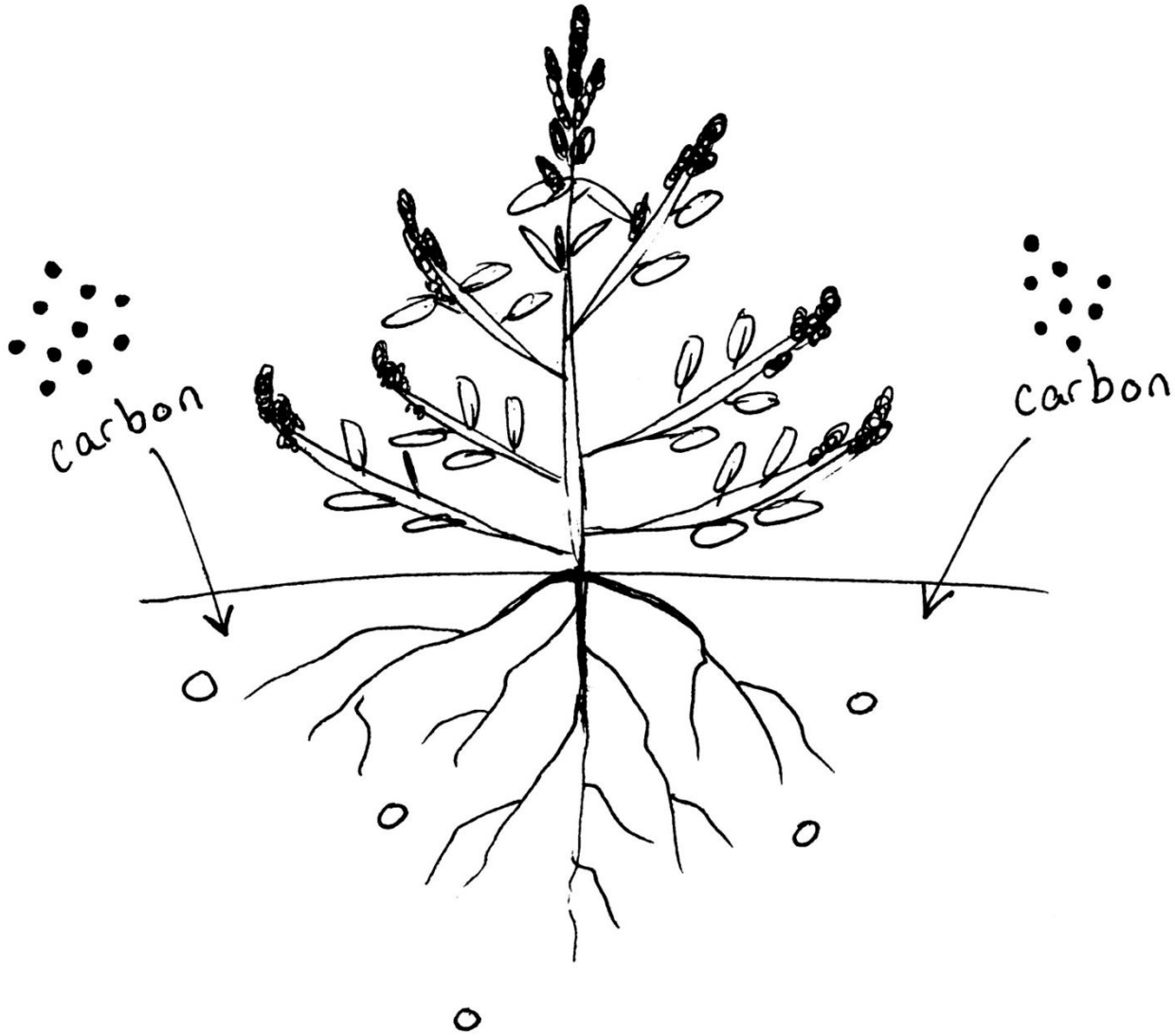
Annual Change in Per Acre Net Income = $55

https://www.nrcs.usda.gov/wps/portal/nrcs/detail/national/soils/health

Our goal was to manage weeds by manipulating the soil environment as a non-herbicide based weed management tool.



Soil carbon additions stimulate the growth of the soil microbial community.



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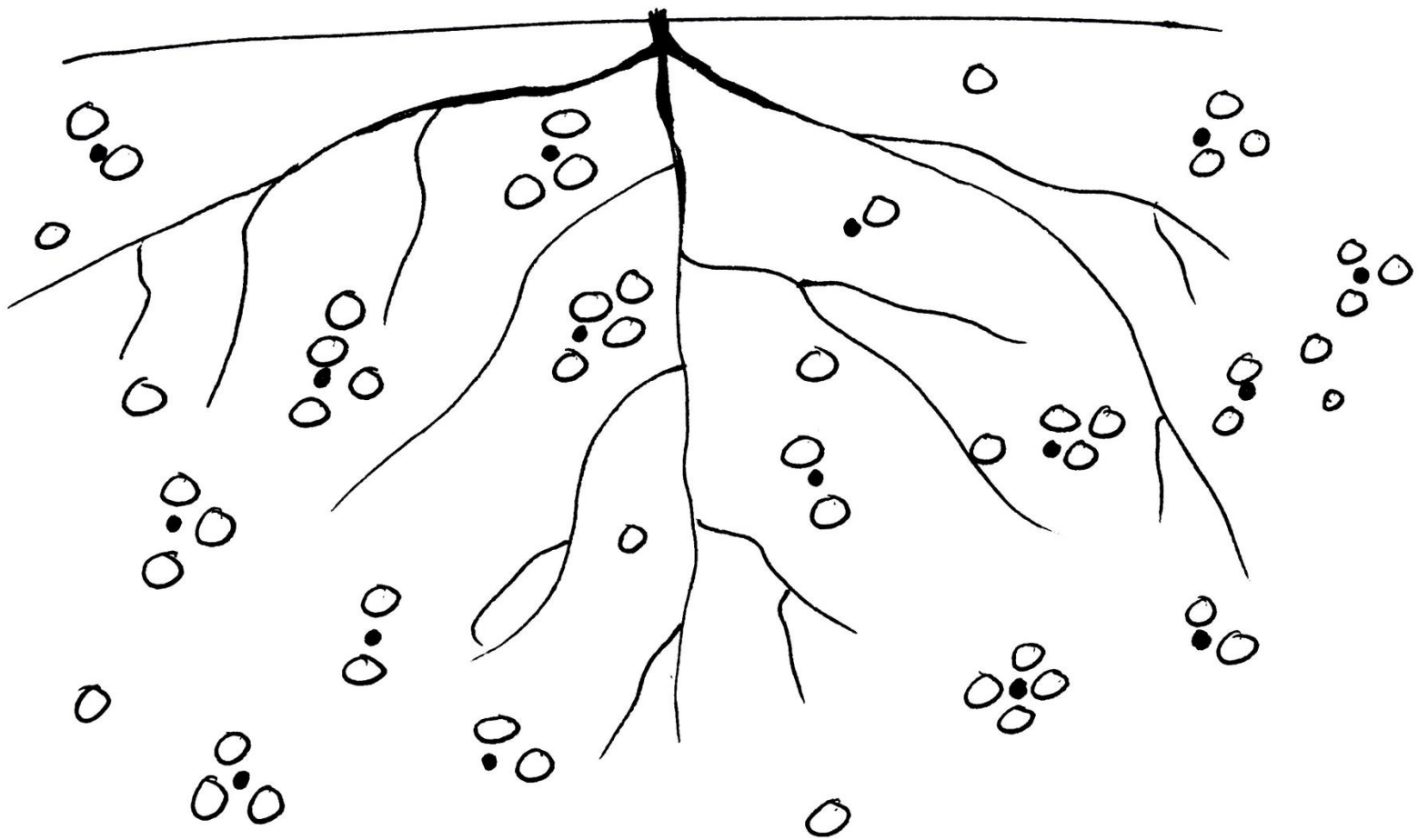
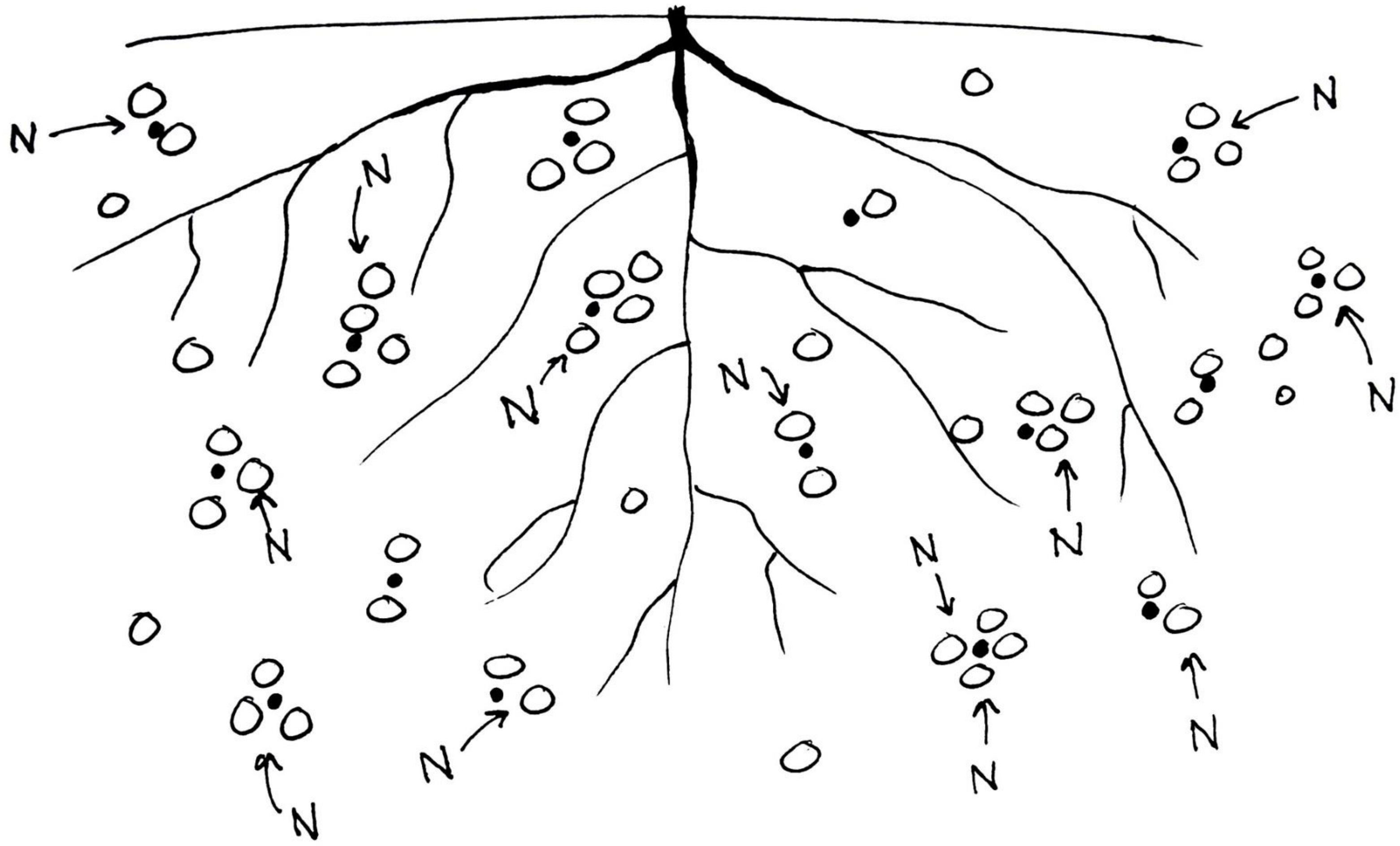
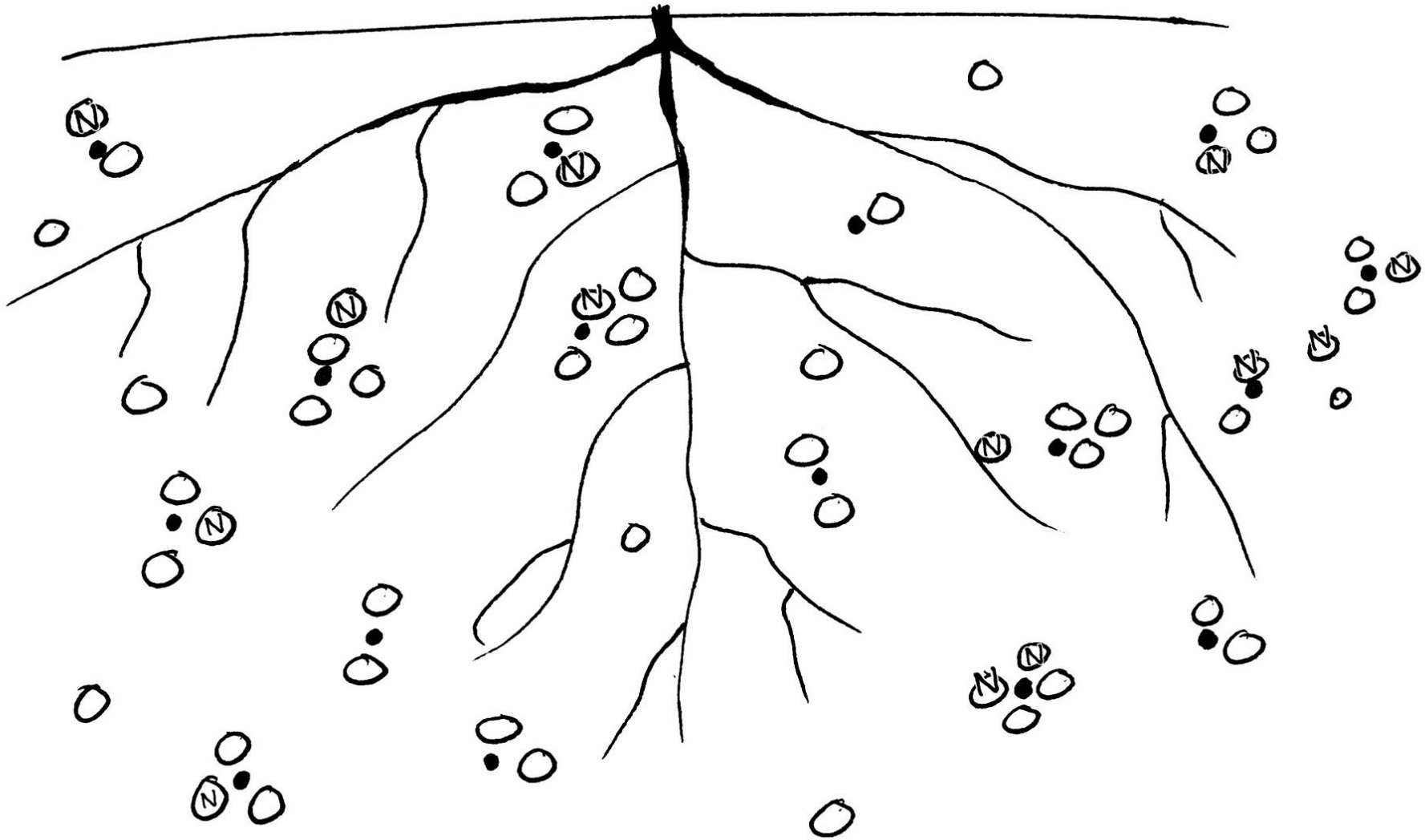


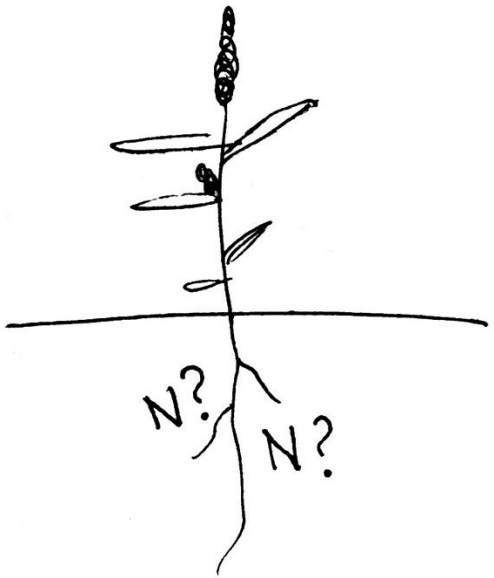
The microbial community takes up available soil nitrogen as they grow.



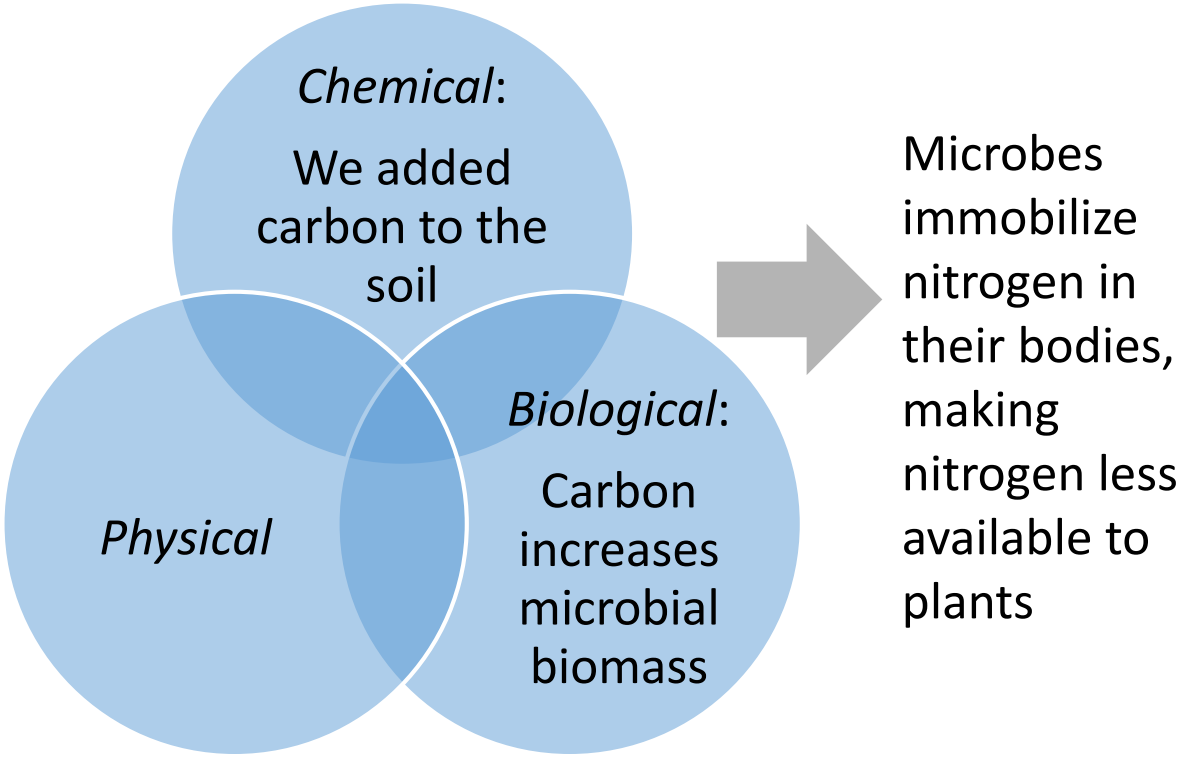
Less nitrogen is available to plants.



Nitrophilous weeds grow less well.



We utilized the interaction of chemical and biological soil components to manage weeds.



Our experiment tested whether carbon would decrease weed and soybean growth at the same rate.

2 plants per pot:
- monocultures and polycultures

3 weed species:
- *Amaranthus powellii*
- *Amaranthus palmeri*
- *Chenopodium album*

2 soybean varieties:
- *Nodule-forming*
- *Non-nodulating*

2 treatments:
- Carbon Added
- No Carbon Added
  - Carbon was a mix of 5% sucrose & 95% sawdust (90% pine)

6 replicates of each pot, grown for 2 months

Nitrogen-loving weed growth was decreased without affecting legume crop growth.

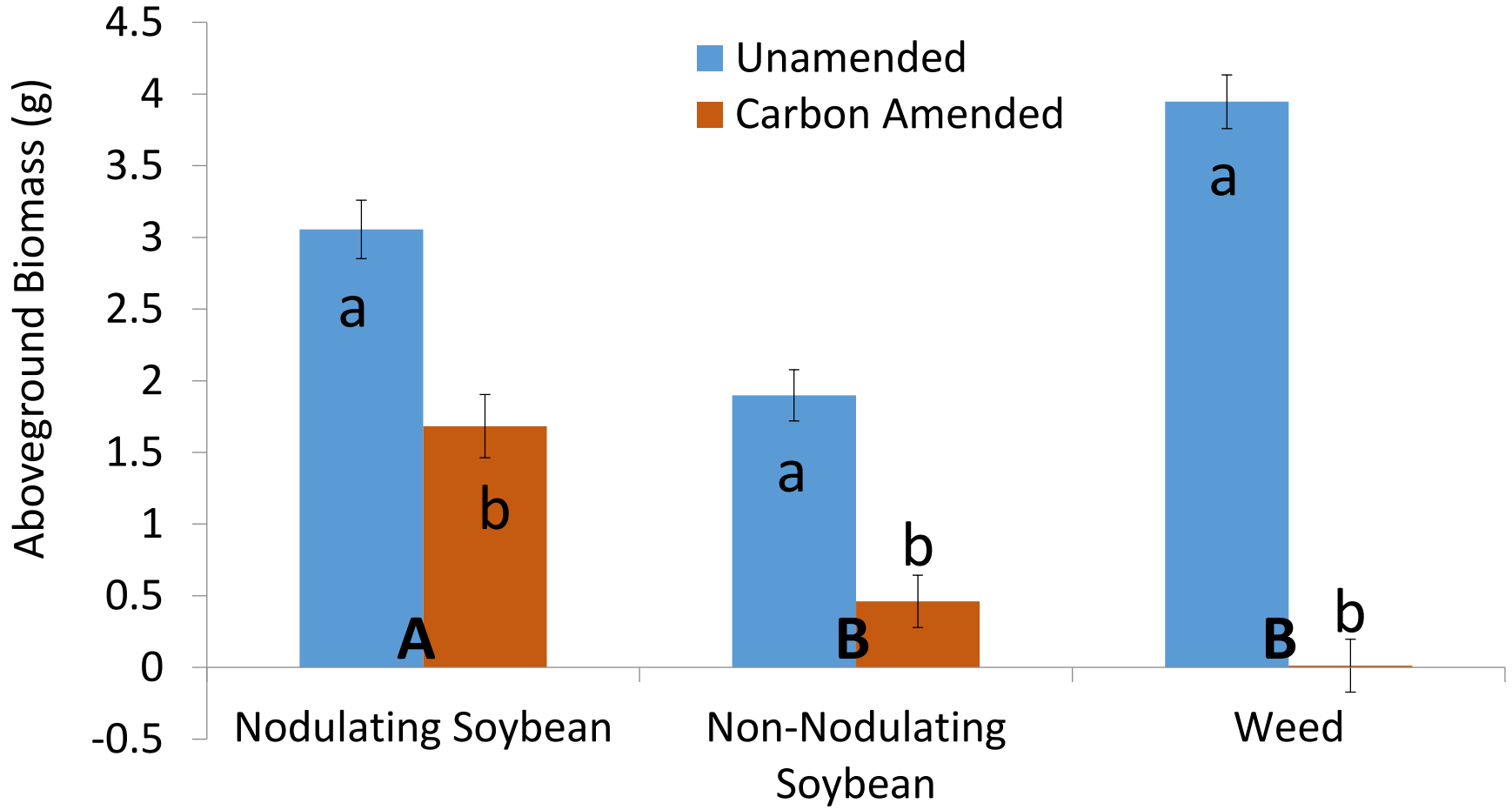


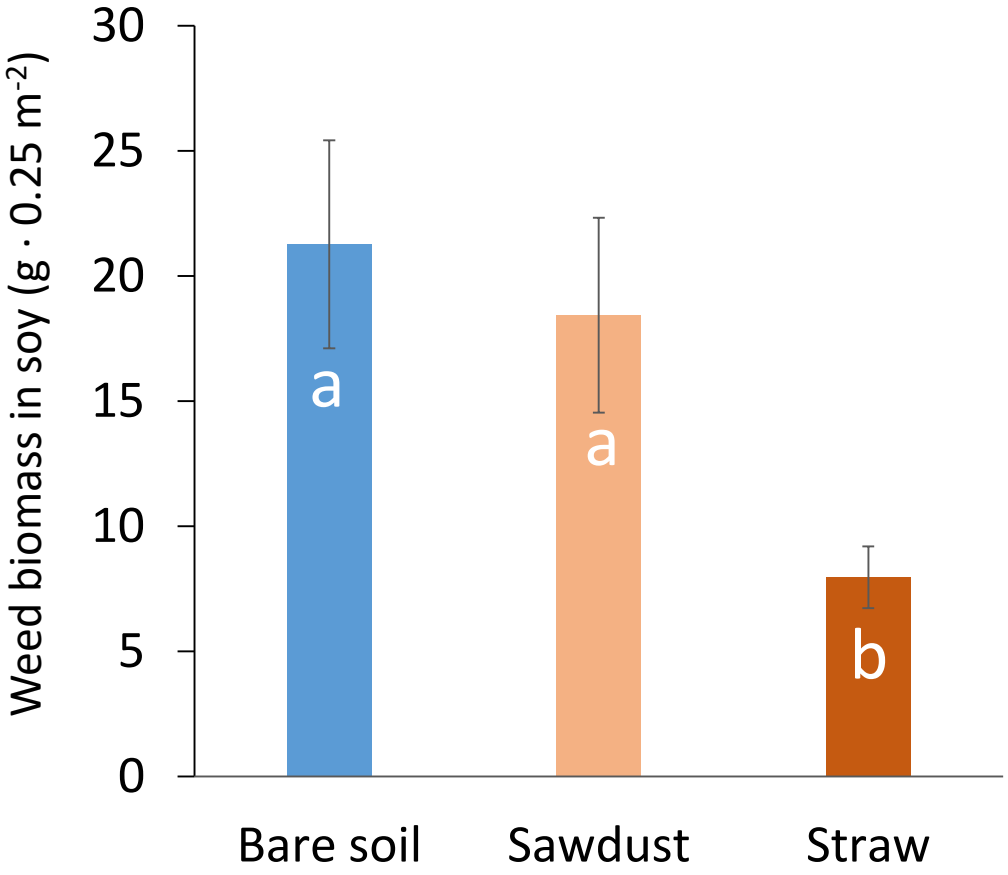
Figure 3. Average plant biomass of soybeans or weeds grown in a greenhouse in pots amended with carbon or unamended. Lowercase letters indicate differences in biomasses when grown in different soils (*p-value* < 0.05) and different uppercase letters indicate differences in biomass decline based on plant species using a Tukey's post hoc analysis of a linear model.

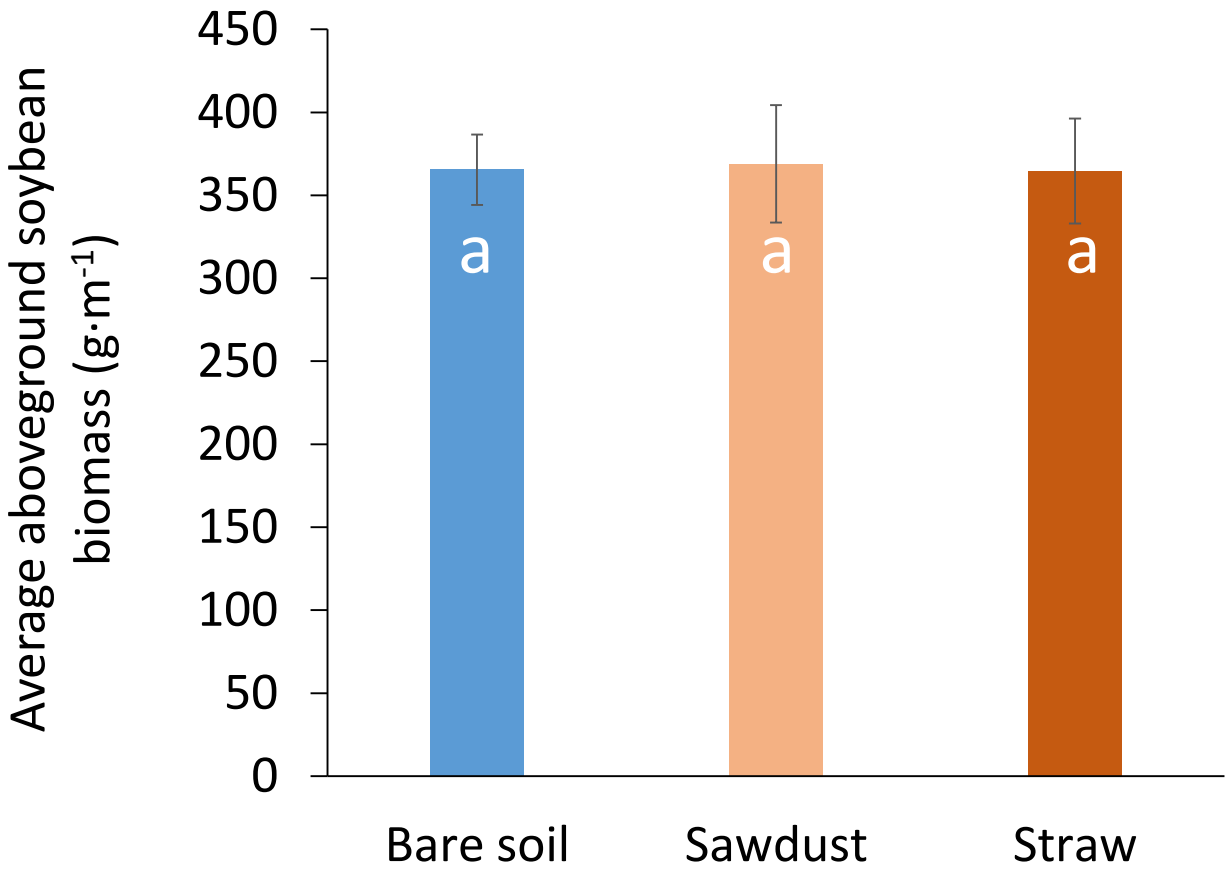
We included a soybean crop in a field experiment to see if this pattern would continue in field conditions

Unamended
Sawdust amended (~100 g·m^2)
Straw amended (~600 g·m^2)

X 8 randomized blocks

Weed biomass decreased in high carbon amended plots in the Field experiment, but soybean biomass did not.





Average total aboveground weed biomass in plots amended with carbon (sawdust or straw) or unamended. Different letters indicate significantly different weights (*p-value* < 0.05, n=8) based on Tukey's post-hoc analysis of a linear model.

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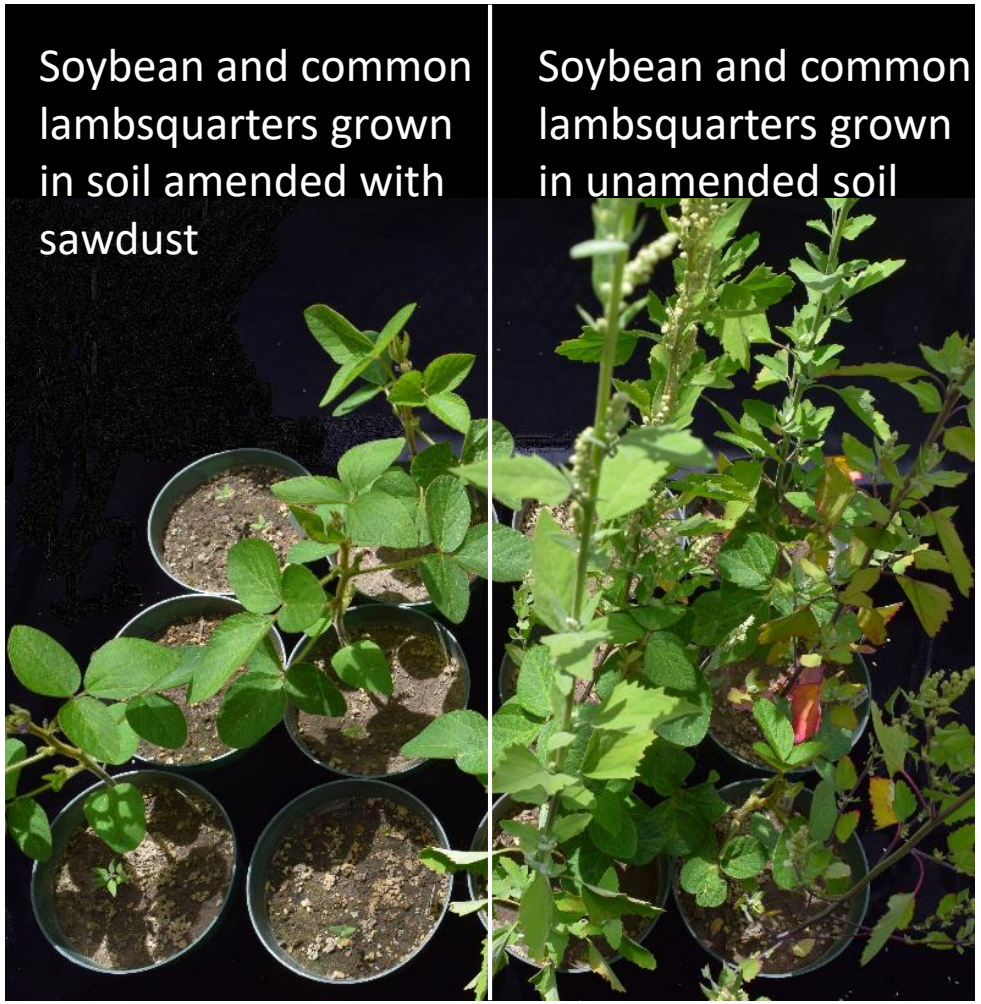

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