Improving Soil Health Using Tillage Techniques to Increase Soil Carbon Sequestration

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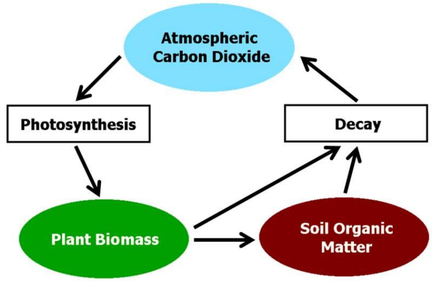
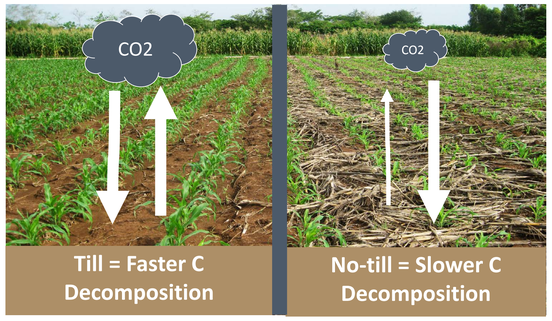
Carbon Sequestration Matters

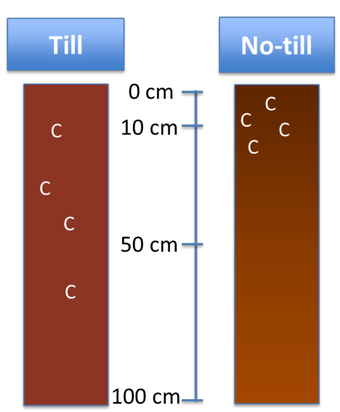
- Soil organic matter storage is a key indicator of soil health and a greenhouse gas mitigation strategy.[1]
- 58% of soil organic matter is soil organic carbon (C).



- Conservation practices (e.g. no-till) sequester more surface C.
- No-till leaves plant litter on the surface and slows decomposition of soil C. [2]

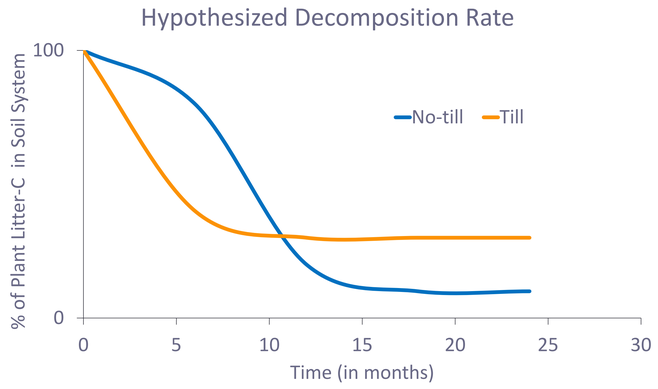


- Many studies don't measure soil organic C below 30 cm, potentially missing C stored deeper in tilled systems.
- Many studies show equal amount of C sequestered in no-till and till when deeper soil is measured.[3-5]
- No-till has even been shown to lose C over time.[6]



Main Question

How does plant litter placement (till or no-till systems) affect C stabilization in soil over time?



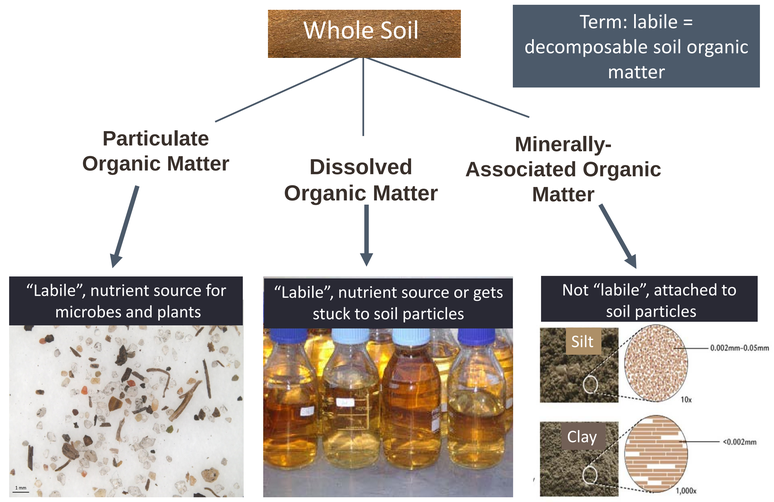
Treatments

Effect of soil/plant litter contact		Effect of soil disturbance	
Disturbance/ Mixed Plant Litter	No disturbance/ Surface Plant Litter	Disturbance/ Mixed Plant Litter	Disturbance/ Surface Plant Litter

Tracing Carbon in Soil

Growth chamber for labelling plants with carbon isotopes	Collar containing plant litter + soil in field	Soil cores taken after letting plant litter decompose	Isotopes measured in soil sample at different depths and fractions

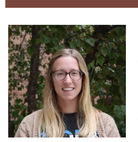
Measuring Carbon Stability



Expected Outcomes

- Periodic tillage will help sequester more plant litter carbon over time despite slower decomposition in no-till.
- Modify farming practices to increase C sequestration thereby improving soil health and decreasing greenhouse gas emissions.

CONTACT INFORMATION/ACKNOWLEDGEMENTS



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1. Moore, et. al. : 1442–1453. 2. Six, et. al 2000. Soil Biol. Biochem. 32(14): 2099–2103. 3. Baker,. 2007. Agric. Ecosyst. Environ. 118(1–4): 1–5. 4. Rumpel, C., and I. Kögel-Knabner. 2011. Plant Soil 338(1): 143–158. 5. Gál et. al. 2007. Soil Tillage Res. 96: 42–51.
6. Halvorson, A.D., and C.E. Stewart. 2015. Agron. J. 107(4): 1504–1512. 7. Stover title picture: https://news.uns.purdue.edu/images/2015/tyner-fieldstover.jpg 8. Carbon cycle picture: dl.sciencesocieties.org; 9. Tillage difference picture: http://www.semillanueva.org/saving-soils/
10. Growth chamber picture:Gregorich, E.G., H. Janzen, B.H. Ellert, B.L. Helgason, B. Qian, B.J. Zebarth, D.A. Angers, R.P. Beyaert, C.F. Drury, S.D. Duguid, W.E. May, B.G. McConkey, and M.F. Dyck. 2017. Litter decay controlled by temperature, not soil properties, affecting future soil carbon. Glob. Chang. Biol. 23(4): 1725–1734. 11. Giddings Probe picture: https://pawillup.wsu.edu/soils/soils/; 12.. POM picture: Hanna Poffenbarger, Iowa State University; 13. DOC picture: www.wsl.ch; 13. Soil particle size picture :https://support.rainmachine.com/hc/en-us/articles/228001248-Soil-Types 14. Healthy soil pic: https://global.nature.org/content/rethinking-soil;

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