Cropping Systems

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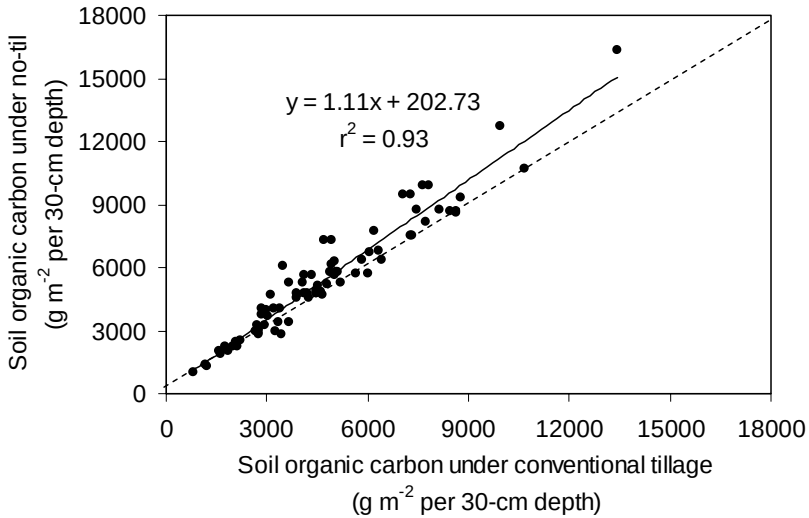
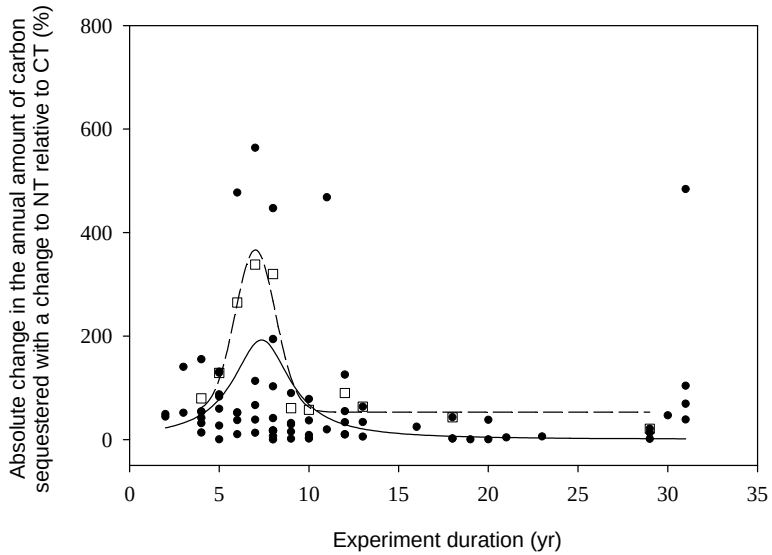
Management Impact on Soil C

- **Analysis completed of 67 long-term agricultural experiments consisting of 276 paired treatments.**
- **Largest effect with change from conventional tillage to no-till.**
- **Crop type and crop rotation has significant effect on rates of SOC change with change in management.**

Conventional till to no-till conversion

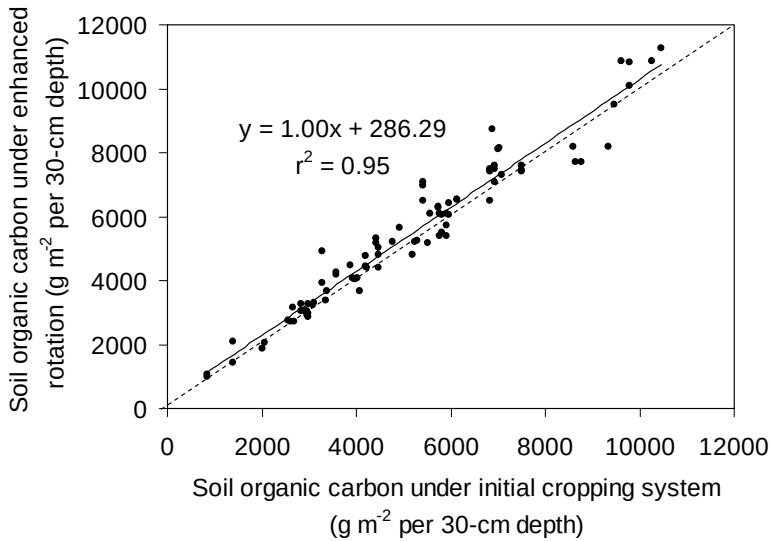
- **Change from conventional to no-till results in an average sequestration rate of 57±14 g C $m^{-2}y^{-1}$ (excluding wheat-fallow).**
- **Wheat-fallow systems show little change in SOC with no-till.**
- **Sequestration rates peak in 5-10 years.**
- **SOC reaches new steady state in 15-20 years.**

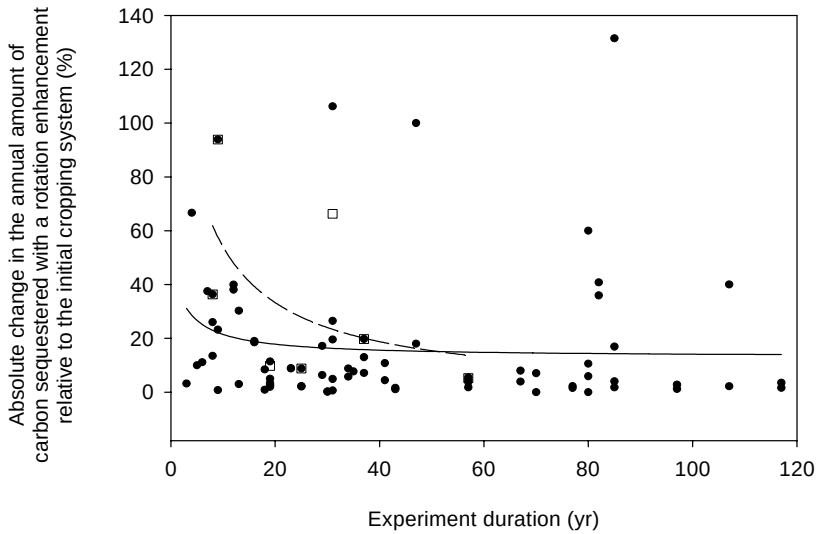




Enhancing crop rotation complexity

- **Enhancing rotation complexity can sequester 20±14 g C $m^{-2}y^{-1}$ (except changing from continuous corn to corn-soybean).**
- **SOC may reach new equilibrium in 40-60 years**





Cover Crops

- **Rodale Farming Systems Trials**
  - **Hairy vetch (*Vicia villosa*) show significant potential to enhance carbon sequestration.**
  - **^{13}C-labeling experiment indicates root derived carbon of vetch is effectively retained as physically protected particulate organic matter.**
- **Cornell cover crop investigations**

Farming Systems Trial (FST)

Rodale Institute

Cumulative aboveground NPP, C returned and net changes in soil C after 15 years.

Cropping system	Net primary productivity	Plant residues returned			Manure input	Total organic residue input	Change in soil C
		Senescent	Living	Total			1981 to1995
		---------- kg C x 10^3 ha^{-1} ----------					
MNR	69a	21	3.7	25a	19	44b	12
LEG	68a	31	7.5	39b	0	39a	6.6
CNV	75b	43	0	43c	0	43b	2.2*

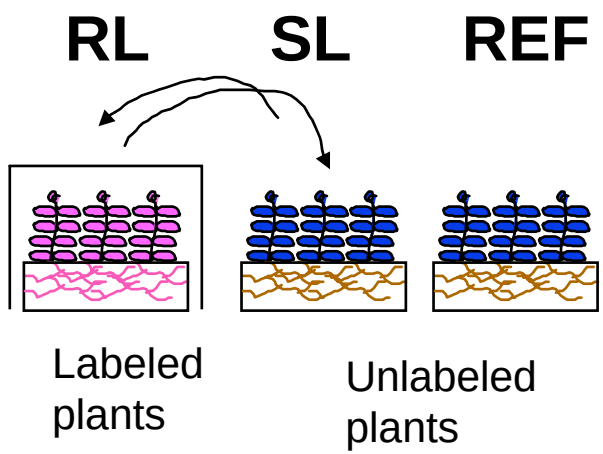
MNR = manure additions
LEG = legume winter cover crop
CNV = conventional tillage

*NS difference 1981 to 1995.

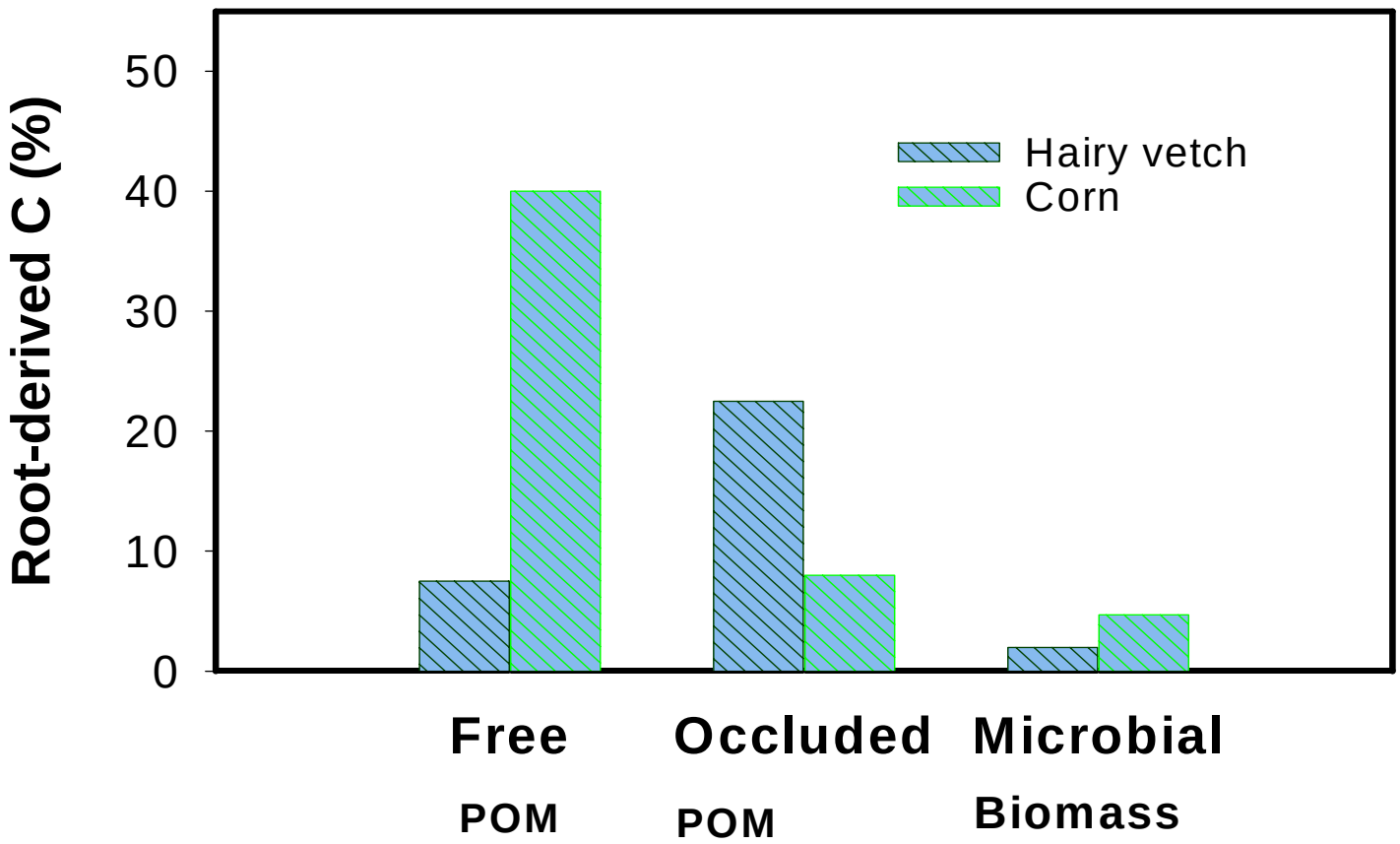
Rodale FST: *in situ* ^{13}C-labeling

- **Examine source effects on decomposition.**
- **Compare fate of litter from two key plant species.**
- **Compare management history effects on decomposition of newly added litter.**

Paired ^{13}C labeled microplots



Fate of root-derived C from corn and hairy vetch



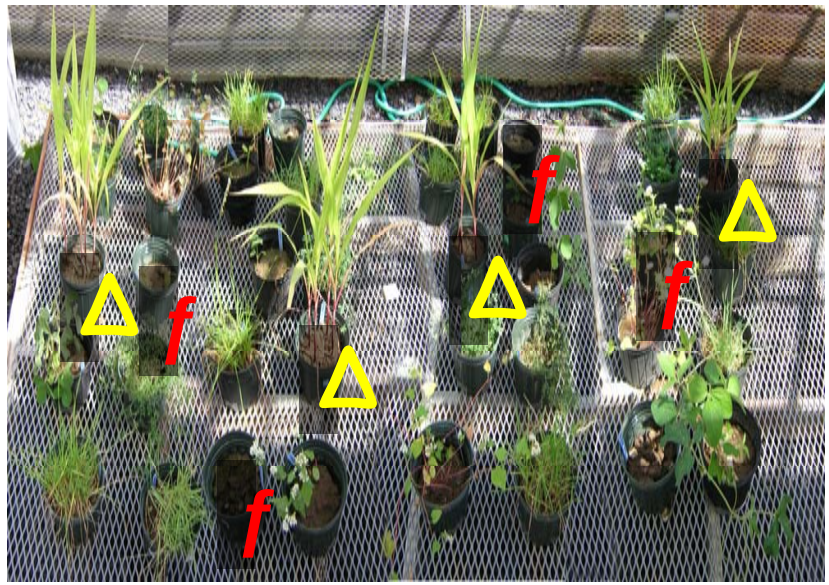
Plant species effects on soil C

- **To understand how plant species influence key processes that regulate C storage (aggregation and decomposition)**
- **To understand the role of plant-microbial interactions in governing these processes**
- **To screen a broad array of commonly used cover crops for their C sequestration potential**

Cornell Cover Crop Experiments

Three experiments:

- **2001:** Small number of warm season species, Legumes versus non-legumes, modify rhizosphere community
- **2002:** Modify the scale of the experiment, continue initial screening of plant species
- **2003-present:** Large experiment with 14 different plant species, planted in monocultures and mixed plots, combined with greenhouse experiments
- Preliminary results show plant rhizosphere has effects on microbial community composition.



Greenhouse-grown replacement plants in corn-soil. Corn (Δ) and no plant (*f*) treatments were used to determine the baseline microbial community.

Summary/Conclusions

- **Plant species effects on decomposition is not limited to litter quality but includes effects on microbial community.**
- **Some species, particularly legumes appear to impact organic matter/soil mineral particle interactions through microbial effects.**
- **Management history also effects decomposition of newly added litter.**