

Managing Soil Ecosystems

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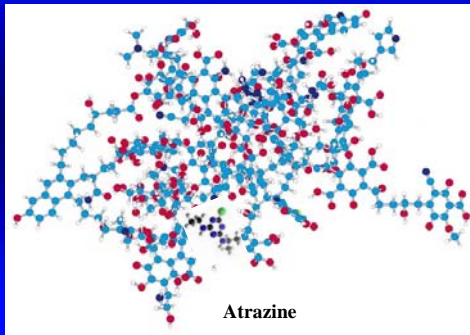
Soil organic matter management is a critical component of soil ecosystem sustainability

- Critical to sustaining nutrient cycling and availability
 - How much input is required?
- Source of nutrients
 - Organic sources often contain imbalances (>P, K)
- Timing of nutrient availability
 - Key issue with organic based fertility (immobilization/mineralization)
- Interactions of amendments with other amendments and soil nutrient pools
 - Critical to determining timing & amount of nutrient availability
- It's a long-term exercise requiring consistency

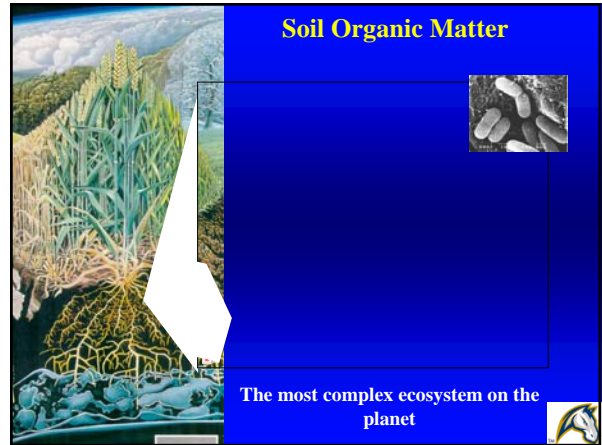


Soil Organic Matter: What is it?

Amorphous, Complex, hydrophobic; waste of life

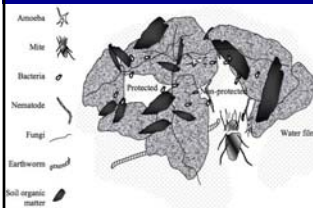


Soil Organic Matter

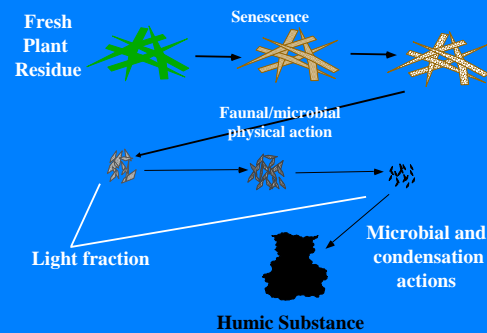


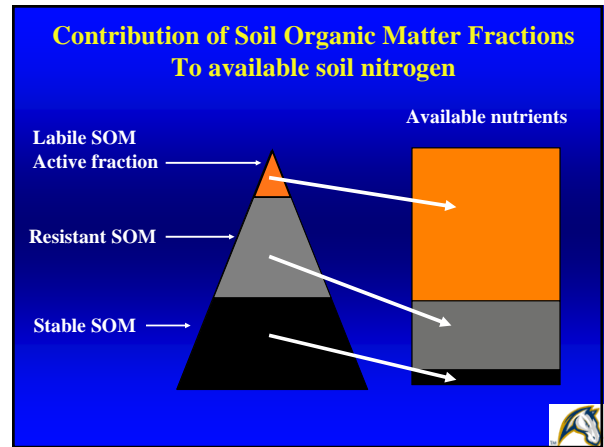
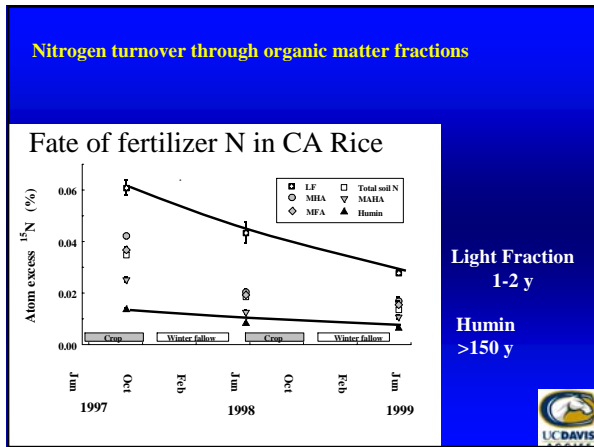
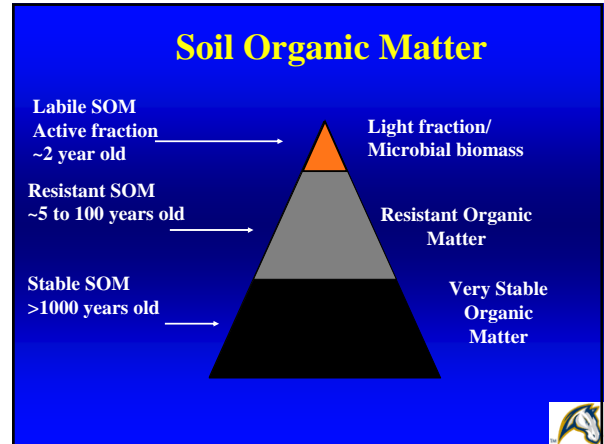
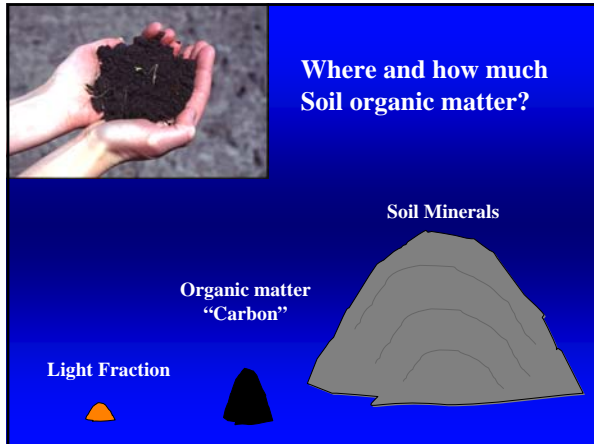
Soil Organic Matter

- Cation Ion Exchange capacity
 - 300 to 700 cmol(+)/kg
- Capacity to chelate metals
- Enhance soil physical properties
 - Water Holding capacity
- Source of nutrients
 - C/N/S/P = 100/10/1/1
- Positive influence on soil properties

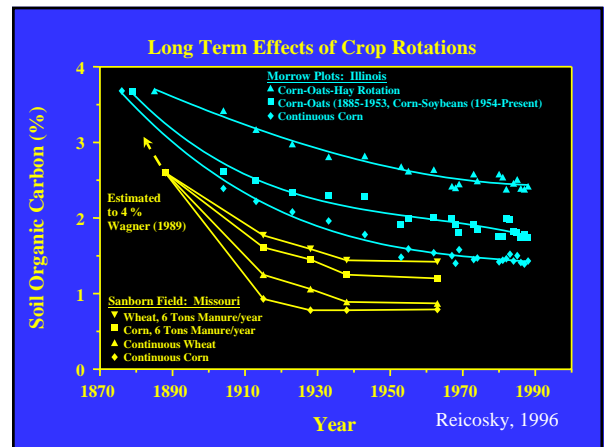


Plant Residue Decomposition and humus formation

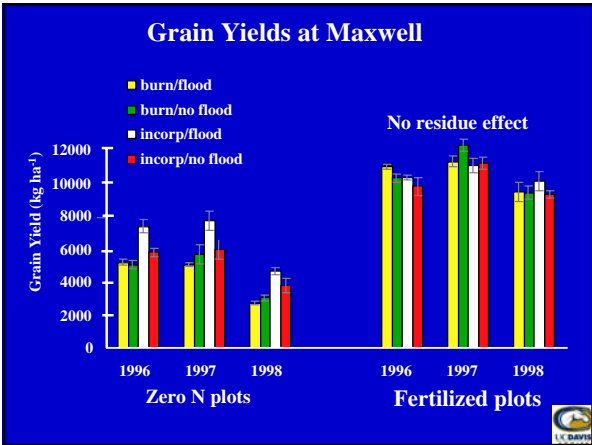
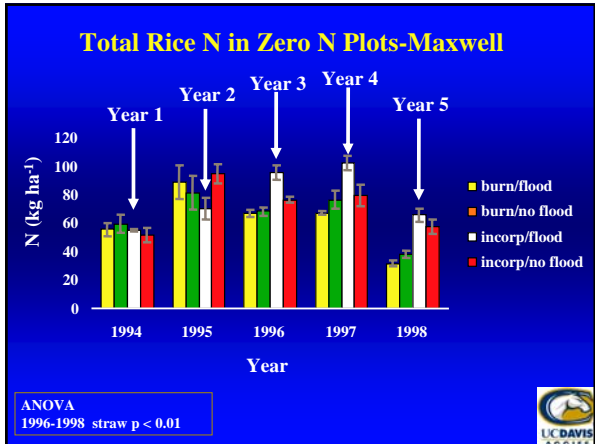




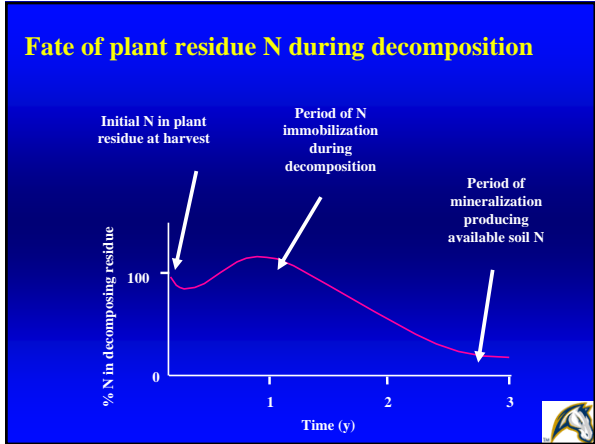
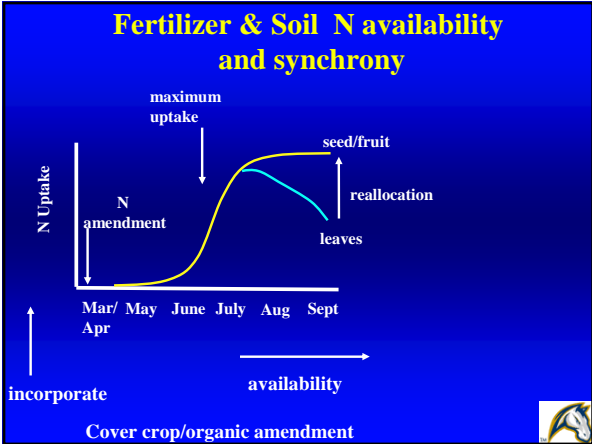
Crop rotation effects

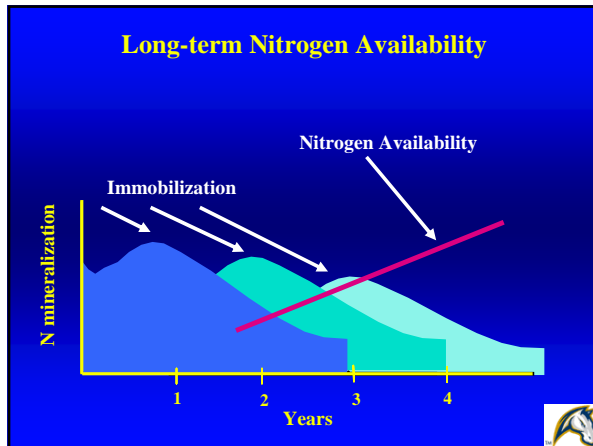


Crop residue effects



Nutrient availability





Soil C and N in Sustainable Agriculture Farming System project under different management.

System	Soil %C			Soil %N	
	Fall 1988	Fall 1996	Fall 2000	Fall 1996	Fall 2000
Organic	0.83	1.08	1.13	0.117	0.116
Low-input	0.83	1.03	1.04	0.111	0.107
Conv-4	0.83	0.90	0.92	0.094	0.095
Conv-2	0.83	0.84	0.88	0.092	0.094

	Carbon	Nitrogen
Organic	5.3 t C ha ⁻¹	462 kg N ha ⁻¹
Cover crop	3.4 t C ha ⁻¹	273 kg N ha ⁻¹

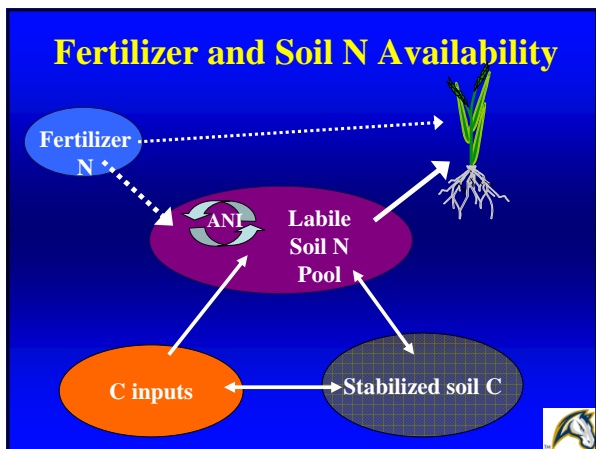
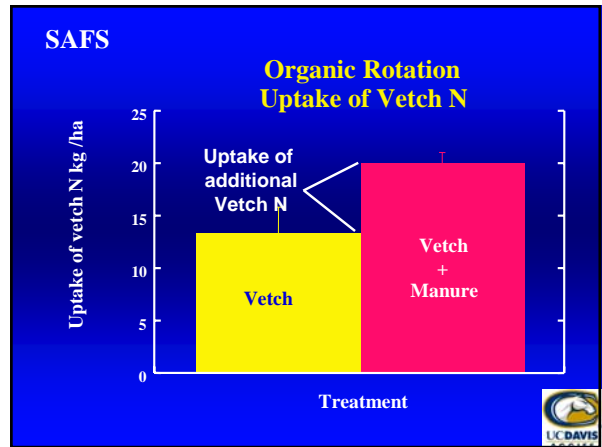
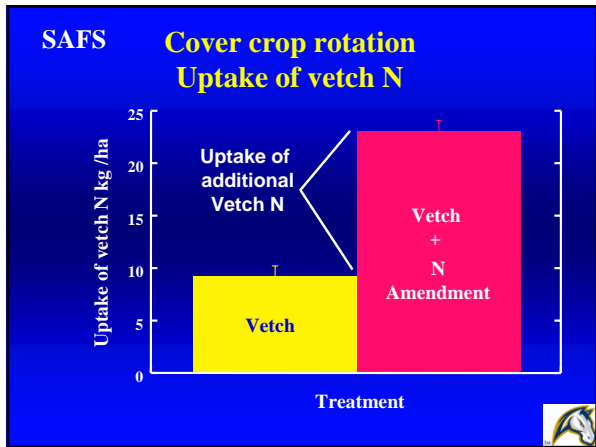
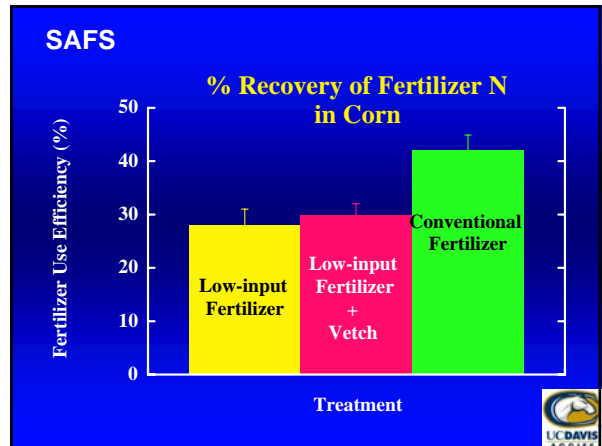
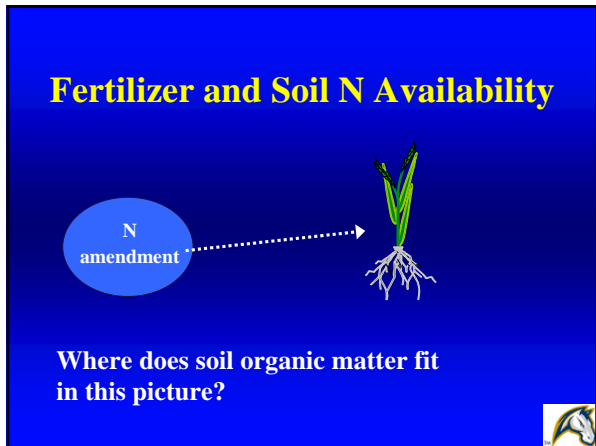
Nutrient imbalance consequences

SAFS Project

Soil pH, extractable P and S expressed as mg kg⁻¹ soil.

Treatment	pH	P	S
Conv-4	6.8 b	12.8 ab	102.1 bc
Conv-2	6.6 c	14.2 ab	97.9 c
LI	7.0 a	11.2 b	113.7 b
ORG	7.0 a	16.5 a	124.3 a

Interaction among soil organic fractions



Cropping system nutrient use efficiency

SAFS N Balance

System	N Input kg/ha	N Output kg/ha	Soil N Storage Kg N/ha*	Loss of N Applied (%)
Organic	1924	933	901	4.6
Low-input	1550	1186	327	2.4
Conv-4	1827	1339	79	22.3
Conv-2	1584	1132	0	28.5

* Soil N 1998 minus Soil N 1989



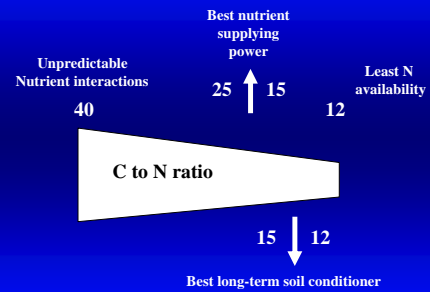
Average yield (ton ha⁻¹) of tomato among different cropping systems.

Cropping System	Marketable Yield	Unmarketable Yield	Total Yield
Conventional	72.2	19.7	91.9
Low-input	72.6	25.4	98.0
Organic	69.0	26.9	95.9



Are all organic inputs the same?

Organic waste Compost



Applies to cover crops too!



Management effects on and soil and environmental quality

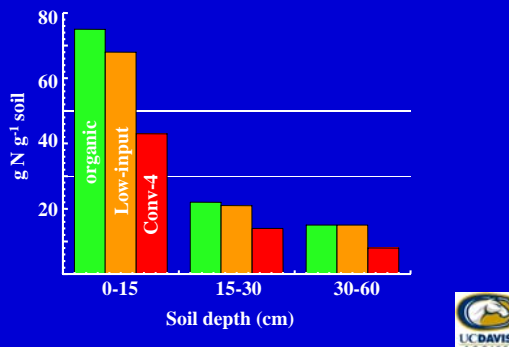
CONVENTIONAL = Winter Fallowed



and **LOW INPUT** = Winter Cover Cropped



Microbial Biomass after 10 years of management at SAFS



Summary

- With appropriate combination of amendments sufficient amount and synchrony of nutrient delivery can be achieved
- Interactions of amendments with other amendments and soil nutrient pools needs further research to fine tune nutrient delivery
- Soil quality improved (nutrient use efficiency optimized)
- Nutrient loss can be minimized
- Value of long-term experiments

Amendments In proper Context



The sustainability of a farm system is only marginally related to fertilizer and other inputs. Intrinsic soil factors such as slope, texture, and local rainfall or irrigation practices, along with management-related factors such as a use of cover crops, soil organic matter, aggregate stability, and tillage practices, have a much greater influence on the sustainability of any given farm than does the type or amount of soil amendments. Shifting from conventional inputs to alternative ones does little to increase overall sustainability.