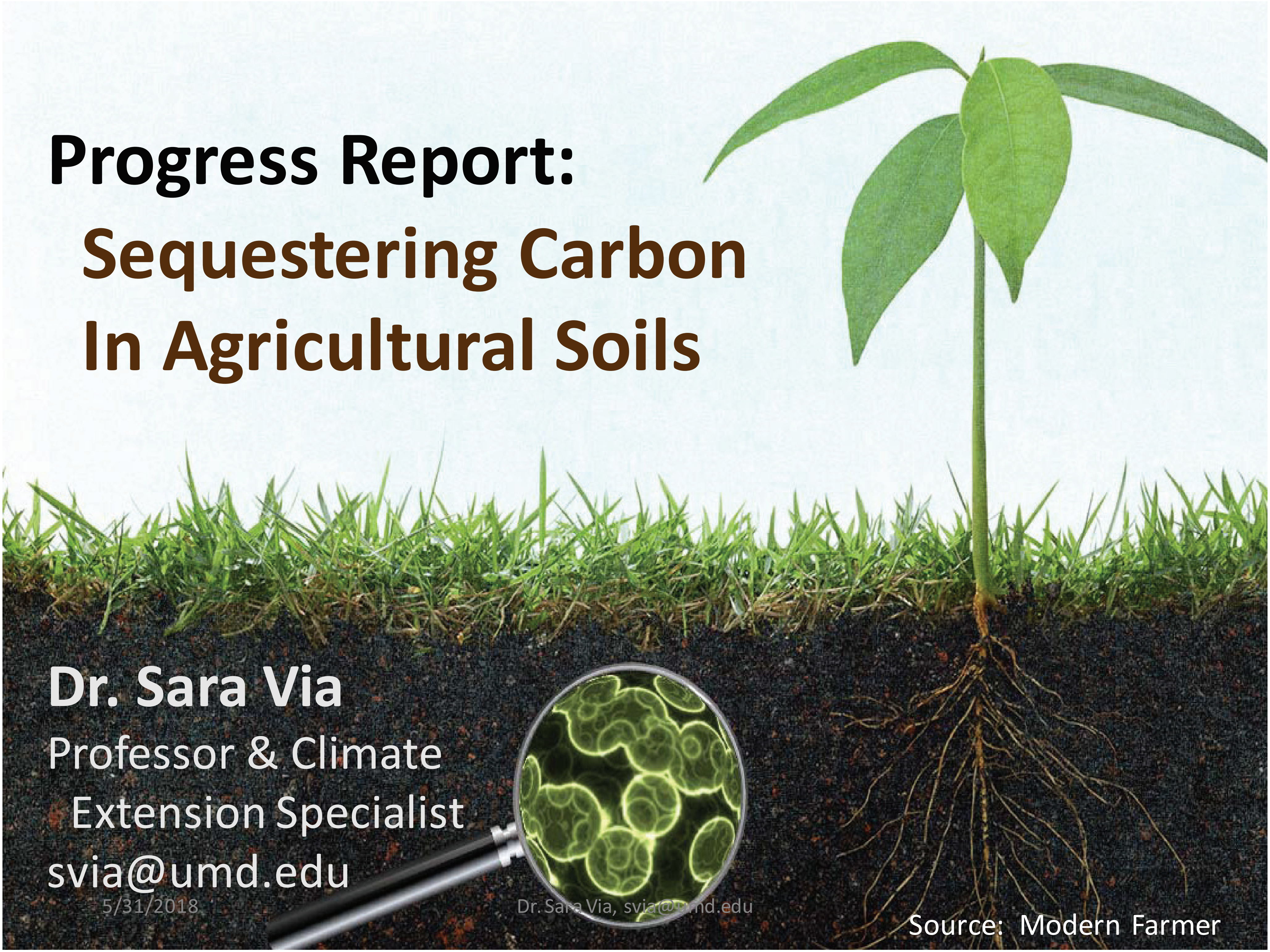

Progress Report:
Sequestering Carbon In Agricultural Soils

Dr. Sara Via

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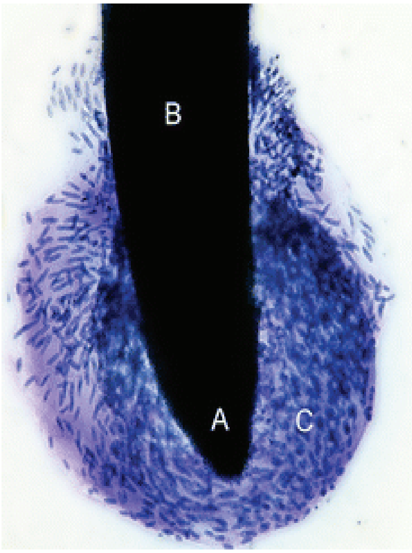
Source: Modern Farmer

Sequestering carbon in healthy soil

Plants absorb atmospheric C during photosynthesis & make sugar



- In healthy soil, up to 40% of this carbon is exuded from roots to feed microbes
- Microbes assemble stable soil aggregates that protect some of this carbon
- Tilling and other disturbance allows microbes to increase decomposition, releasing CO_2)
- Carbon deposited deep is less vulnerable

Goals

1. Identify research-based strategies for sequestering C on Maryland's farms
2. Estimate potential GHG reduction from each
3. Determine costs/benefits for each
4. Determine ways to build on the current cover crop program to incentivize increased use of these strategies
5. Prepare White Paper for MDA, MCCC describing program for 2019 GGRA Plan

Identifying research-based strategies

- **Review major scientific reports** on carbon sequestration from past 15 years (citations available on request)
- **Consolidate results**, evaluate support
- **Align with NRCS conservation practices**
    - many already used in MD for water quality & soil health
    - CA Healthy Soils grants based on these
    - COMET-Planner calculates GHG benefits

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Magnitude of GHG reduction for each sequestration strategy

Values from COMET-Planner	GHG reduction (MT CO2e/acre/yr)				
	Carbon Dioxide (CO_2)		Nitrous Oxide (N_2O)		
NRCS Conservation Practices					
Cropland Management	**Range**	**Mean**	**Range**	**Mean**	**Sum**
Conventional Tillage to No Till (CPS 329, s)	0.13 - 0.77	**0.42**		**-0.11**	**0.31**
Conventional Tillage to Reduced Tillage (CPS 345, s)	0.02 - 0.22	**0.13**	0 - 0.15	**0.07**	**0.2**
Reduced Tillage to No Till		**0.29**		**-0.4**	**0.25**
Nutrient Management - N Fertilizer Management (CPS 590, s, m)				**0.11**	**0.11**
Conservation Crop Rotation (CPS 328, s)	0 - 0.49	**0.21**	0 - 0.02	**0.01**	**0.22**
Cover Crops (CPS 340, s)	0.16 - 0.46	**0.32**	0 - 0.10	**0.05**	**0.37**
Maryland Farmers are already doing many of these!!					
Cropland to Herbaceous or Woody Cover					
Retiring marginal soils ==> permanent grass cover (CPS 327,s	-0.64 - 1.34	**0.98**	0 - 0.50	**0.28**	**1.26**
Insert forage planting into rotation (CPS 512, s)	0 - 0.49	**0.21**	0 - 0.02	**0.01**	**0.22**
Convert cropland strips to permanent herbaceous vegetation					
Vegetative barriers (CPS 601)	0.64 - 1.34	**0.27**	0 - 0.50	**0.28**	**0.55**
Riparian herbaceous cover (CPS 390)	0.64 - 1.34	**0.27**	0 - 0.50	**0.28**	**0.55**
Contour buffer strips (CPS 332)	0.64 - 1.34	**0.27**	0 - 0.50	**0.28**	**0.55**
Field border (CPS 386)	0.64 - 1.34	**0.27**	0 - 0.50	**0.28**	**0.55**
Filter Strip (CPS 393)	0.64 - 1.34	**0.27**	0 - 0.50	**0.28**	**0.55**
Grassed Waterway (CPS 412)	0.64 - 1.34	**0.27**	0 - 0.50	**0.28**	**0.55**
Convert cropland to Farm Woodlot (CPS 612)	1.17 - 3.83	**1.98**	0 - 0.50	**0.28**	**2.26**
Windbreak/shelterbelt establishment (CPS380)	0.89 - 3.60	**1.81**	0 - 0.50	**0.28**	**2.09**
Riparian Forest Buffer Establishment (CPS (391)	0.96 - 3.26	**2.19**	0 - 0.50	**0.28**	**2.47**
Hedgerow Planting (CPS 422)	1.06 - 1.89	1.42	0 - 0.50	**0.28**	**1.7**
Alley Cropping (CPS 311)	0 - 3.43	1.71	0 - 0.05	**0.03**	**1.74**
Multistory Cropping = Permaculture (CPS 379)	0 - 3.43	1.71	0 - 0.05	**0.03**	**1.74**

etc.

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Other possible sequestration strategies

Cropland to Herbaceous or Woody Cover (cont.)	CO_2	N_2O	Sum	see labels on previous slide
Convert cropland to Farm Woodlot (CPS 612)	**1.98**	**0.28**	**2.26**	
Windbreak/shelterbelt establishment (CPS380)	**1.81**	**0.28**	**2.09**	
Riparian Forest Buffer Establishment (CPS (391)	**2.19**	**0.28**	**2.47**	
Hedgerow Planting (CPS 422)	1.42	**0.28**	**1.70**	
Alley Cropping (CPS 311)	1.71	**0.03**	**1.74**	
Multistory Cropping = Permaculture (CPS 379)	1.71	**0.03**	**1.74**	
Grazing				
Silvopasture on grazed grassland/pasture (data gaps)	1.34	0.00	**1.34**	
Rotational grazing (from T-AGG,data gaps)	range CO_2: -5.27 - 1.90			
Other strategies from T-AGG with low research support				
improve irrigation management, e.g. drip	possible, but data gaps			
Improve manure managem for lo N_20	possible, but data gaps			
manage farmed histosols	possible, but data gaps			
rotational grazing	new data suggests CO_2 benefit may balance methane from cattle			
agroforestry on grazing land	possible, but data gaps			
Replace N Fertilizer with Soil Amendments (CPS 590)	**1.75**	**0.00**	**1.75**	but life cycle problems
convert dryland to irrigated	life cycle problems?			
biochar	life cycle problems?			

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Greenhouse Gas Reductions: Selected Agricultural Practices, Cumulative and Future

	GHG reduction (MT CO_2e/ac/yr)				GHG	Future GHG	
NRCS Conservation Practices	(CO_2)	(N_2O)		# acres	reduction	# acres	reduction
Cropland Management	Mean	Mean	Sum	2013*	2013*	new	new/yr
Conventional Tillage to No Till (CPS 329, s)	0.42	-0.11	0.31	965,000	299,150	45,000	13,950
Conventional Tillage to Reduced Tillage (CPS 345, s)	0.13	0.07	0.2	290,000	58,000		
Reduced Tillage to No Till	0.29	-0.4	0.25			290,000	72,500
Nutrient Management - N Fertilizer Management (CPS 590, s,m)	0	0.11	0.11				
Conservation Crop Rotation (CPS 328, s)	0.21	0.01	0.22				
Cover Crops (CPS 340, s), 2017 data	0.32	0.05	0.37	559,000	206,830	400,000	148,000
Has cumulative reduction since 2006 been added?			total MTCO2e/yr		563,980		234,450
If average 2007-17 ~ 450,000Mt/yr, then 4.5MMtCO2e reduced since 2007					2013 (no-till), 2017 covers		future/yr
More than RPS (4.13MMT), RGGI (3.60 MMT)		(current + future)/yr:			798,430	MTCO2e/yr	
		just from no-till and cover crops					
Cropland to Herbaceous or Woody Cover							
Retiring marginal soils ==> permanent grass cover (CPS 327,s)	0.98	0.28	1.26	x		?	
Insert forage planting into rotation (CPS 512,s)	0.21	0.01	0.22	x		?	
Convert cropland strips to permanent herbaceous vegetation							
Vegetative barriers (CPS 601)	0.27	0.28	0.55	x		?	
Riparian herbaceous cover (CPS 390)	0.27	0.28	0.55	x		?	
Contour buffer strips (CPS 332)	0.27	0.28	0.55	x		?	
Field border (CPS 386)	0.27	0.28	0.55	x		?	
Filter Strip (CPS 393)	0.27	0.28	0.55	x		?	
Grassed Waterway (CPS 412)	0.27	0.28	0.55	x			

etc.

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Economic, Environmental & Health Benefits (usually multiple)

- **Economic benefits,** such as
  - increased soil health worth $40-140/acre
  - reduced erosion saves $$
  - less nitrate in water saves purification costs
  - overall benefit, varies with carbon price
- **Environmental/Health Benefits,** such as
  - improved water quality
  - reduced erosion, dust, sediment
  - reduction in future climate change

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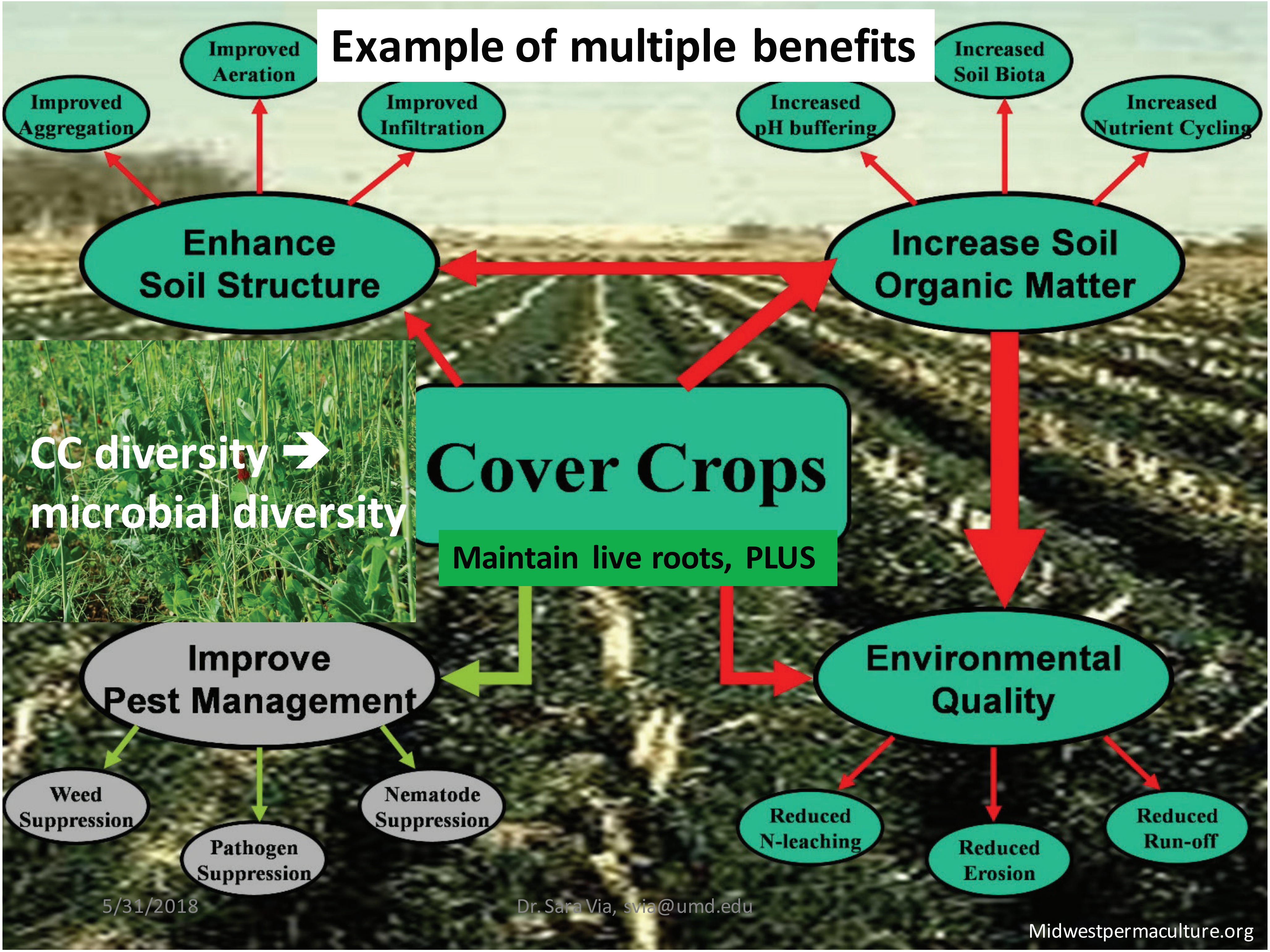
Example of multiple benefits



Fine-tuning the strategies with UMD Extension educators and farmers

- Make the strategies work with methods already in use (i.e., rotations, varieties)
- identify ways to increase value of each strategy (i.e., make cover crops work harder w/diversity, interseeding, planting green, role in weed control)
- identify strategies to increase farmer acceptance and use (i.e., no-till & cover crops in vegetables)

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Write White Paper for MDA, MCCC

- Summarize strategies & GHG reduction potential
- Include economic, environmental & health benefits/costs
- Describe incentive program that builds on & extends current cover crop program, NRCS incentives
- Identify problems to be solved, need for additional personnel
- Timeline? How much detail?

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