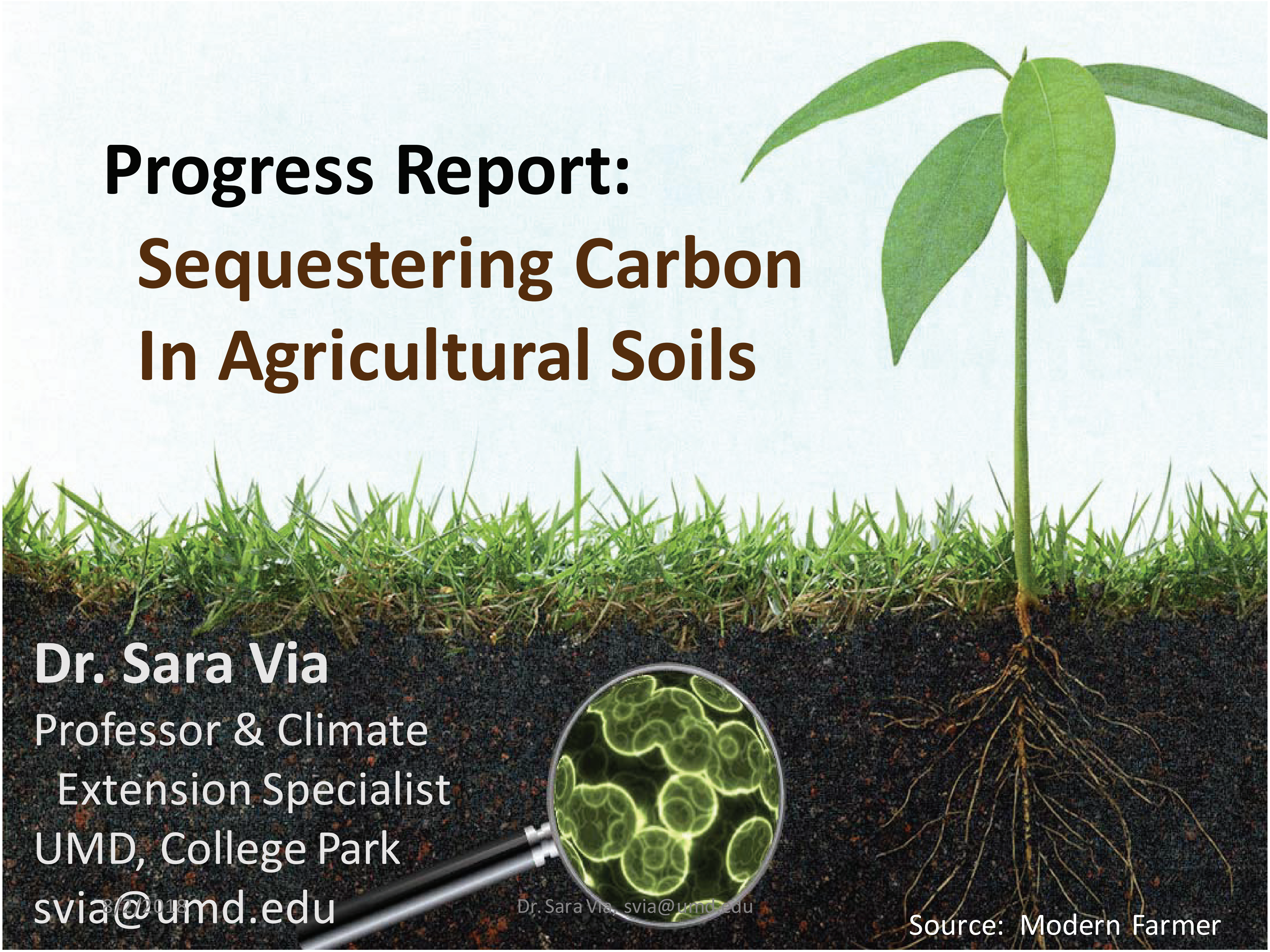

Progress Report:

Sequestering Carbon In Agricultural Soils

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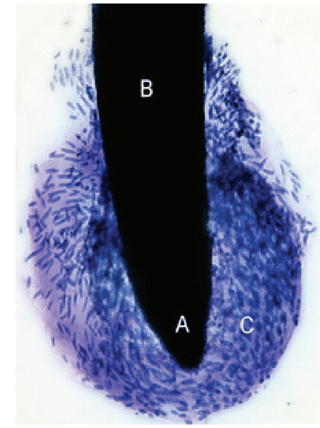
Source: Modern Farmer

Reducing Emissions Is Not Enough

Land-based carbon sequestration the most practical & effective strategy to remove carbon from the atmosphere

- forests
- farms

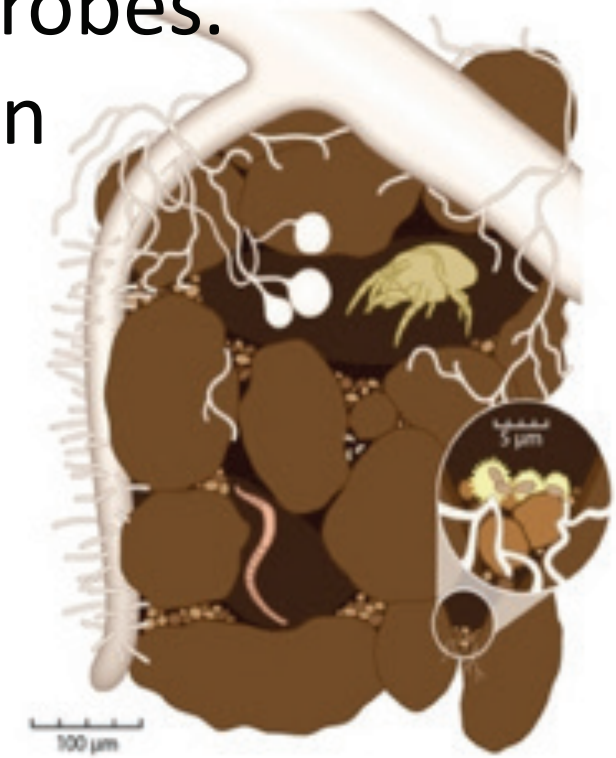
Sequestering Carbon in Healthy Soil



Plants absorb atmospheric C during photosynthesis and make sugar

- In healthy soil, up to 40% of this carbon is exuded from roots to feed microbes. C also comes from decomposition

- Carbon stabilized in soil
  - within aggregates
  - by adsorption onto clay & minerals



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Goals

1. **Identify research-based strategies (BMPs)** for sequestering C on Maryland's farms.
2. **Estimate potential GHG reduction** from each.
3. **Determine costs/benefits** for each.
4. **Explore ways to build on current incentive programs** to increase use of key practices
5. **Prepare White Paper** for MDA, MDE, MCCC describing program for 2019 GGRA Plan.

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Identifying Research-based Practices

- **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 and soil health, incentives established
  - CA Healthy Soils grants use NRCS BMPs
  - COMET-Planner calculates GHG benefits

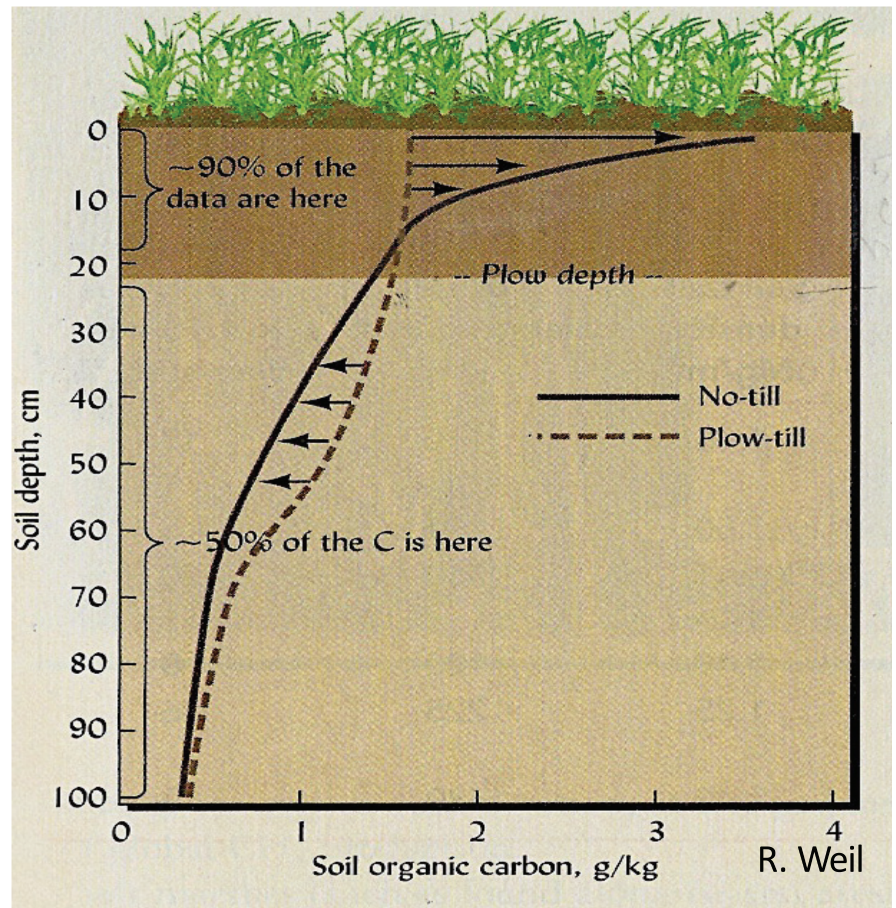
No-Till or Not??

- **No-till a key element of soil health**
- **Co-benefits:** better water infiltration and storage, less erosion, less compaction, less fuel use

-**BUT** some studies that measure C to 1m suggest more C at surface but less at depth in no-till

* Mechanism still uncertain

* California uses no-till as sequestration practice



Greenhouse Gas Reductions From Agricultural Practices, Current

comet-planner.nrel.colostate.edu/COMET-Planner_Report_Final.pd	GHG red (MT CO_2e/ac/yr)				
NRCS Conservation Practices	**(CO_2)**	**(N_2O)**			
Cropland Management	**Mean**	**Mean**	**Sum**	**acres 2017**	**CS in 2017**
Conventional Tillage to **No Till (CPS 329, s)**	**0.42**	**-0.11**	**0.31**	1,079,000	334,490
Conventional Tillage to **Reduced Tillage (CPS 345, s)**	**0.13**	**0.07**	**0.2**		-
Nutrient Management - N Fertilizer Management (CPS 590, s,	**0**	**0.11**	**0.11**		-
Conservation Crop Rotation (CPS 328, s)	**0.21**	**0.01**	**0.22**	304625	67,018
Cover Crops (CPS 340, s), 2017 data	**0.32**	**0.05**	**0.37**	559000	206,830
Cropland to Herbaceous or Woody Cover					-
Retiring marginal soils ==> permanent grass cover (CPS 327,s)	**0.98**	**0.28**	**1.26**	27555	34,719
Insert forage planting into rotation (CPS 512,s)	**0.21**	**0.01**	**0.22**	13416	2,952
Convert cropland strips to permanent herbaceous vegetation					-
Riparian herbaceous cover (CPS 390)	**0.27**	**0.28**	**0.55**	13113	7,212
Contour buffer strips (CPS 332)	**0.27**	**0.28**	**0.55**	8.5	5
Field border (CPS 386)	**0.27**	**0.28**	**0.55**	703	387
Filter Strip (CPS 393)	**0.27**	**0.28**	**0.55**	30837	16,960
Grassed Waterway (CPS 412)	**0.27**	**0.28**	**0.55**	6237	3,430
Cropland to Herbaceous or Woody Cover (cont.)	**CO_2**	**N_2O**	**Sum**		
Convert cropland to Farm Woodlot (CPS 612)	**1.98**	**0.28**	**2.26**	1928	4,357
Windbreak/shelterbelt establishment (CPS380)	**1.81**	**0.28**	**2.09**	120	251
Riparian Forest Buffer Establishment (CPS (391)	**2.19**	**0.28**	**2.47**	19439	48,014
Hedgerow Planting (CPS 422)	1.42	**0.28**	**1.70**	15.4	26
		2017 MtCO2e with no-till =			**726,651**
Grazing		**2017 MtCO2e w/o no-till =**			**392,161**
Silvopasture on grazed grassland/pasture (data gaps)	1.34	0.00	**1.34**		
Rotational grazing (from T-AGG,data gaps)	CS can be > CH4 from cattle				
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_2O	possible, but data gaps				
rotational grazing-new data suggests CO2 benefit may balance methane from cattle					
Replace Synthetic N with manure, compost)but life cycle problems	**1.75**	**0.00**	**1.75**		
biochar	life cycle problems?				

Though not a stated initiative, agricultural soils contributing to 2020 goal

GHG reduction from agriculture 2007 - 2017
With no-till = 6.15 MMt
Without no-till = 3.14 MMt

Calculated using actual # acres in NRCS practices each year w/ estimated GHG reduction for each.

Context: Over same time frame,
RGGI reduced GHGs by 2.86MMt

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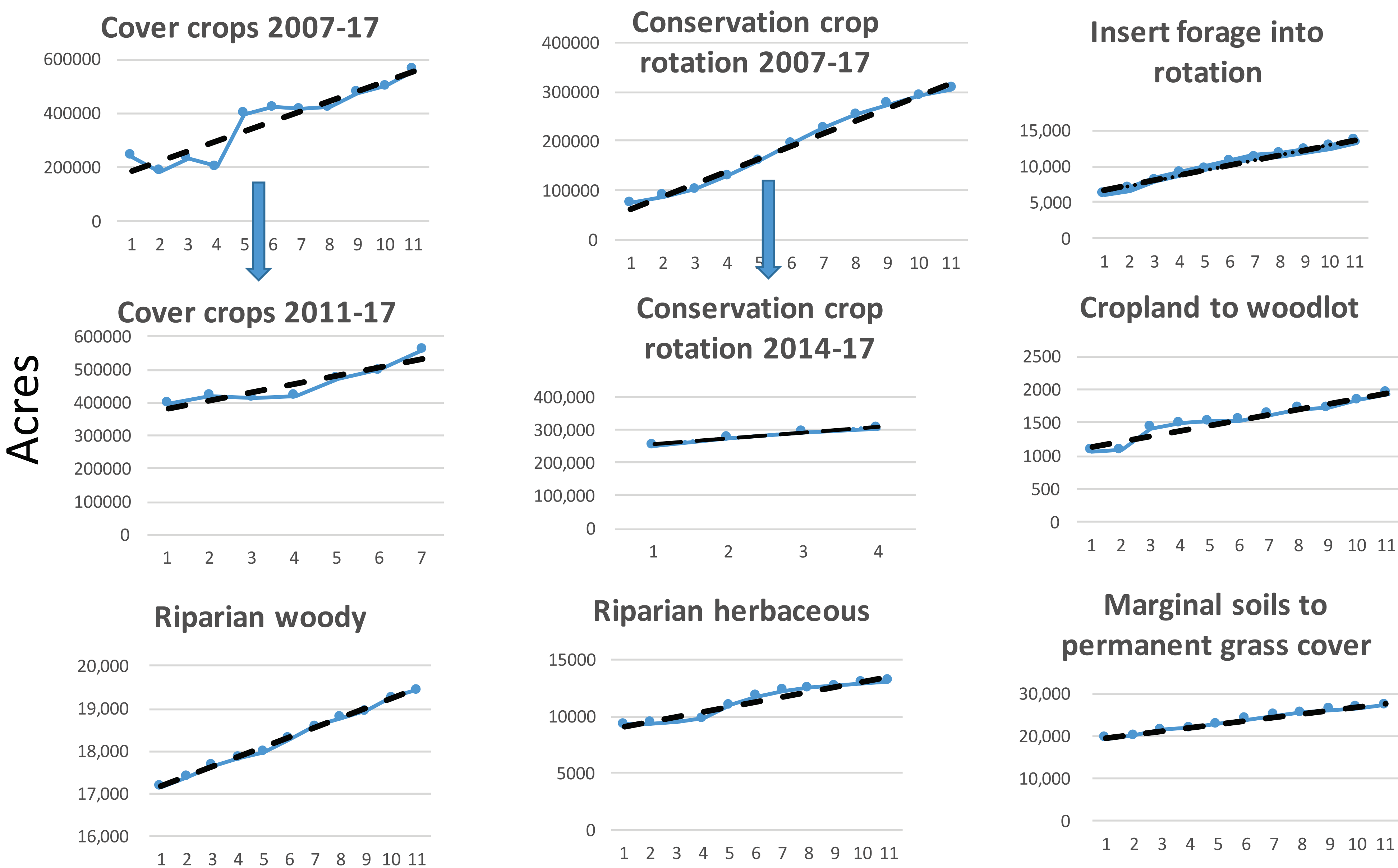
Acreage increases 2007-2017 mostly linear:

Used slopes to estimate acreages 2020-2030



Year (2007-2017)

acreage data provided by
Alisha Mulkey, MDA

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Contribution of agricultural soils to 40 x 30 goal

GHG reduction 2020- 2030 No New Practices		
	w/ no-till :	8.8 MMt
	w/out no-till :	5.23 MMt

- Used 2007-2017 slopes to estimate acreages 2020-30
- Conservative b/c new practices will be added and other practices will increase with funding for carbon benefit

Will cover 33% - 56% of worst case shortfall (16MMt)

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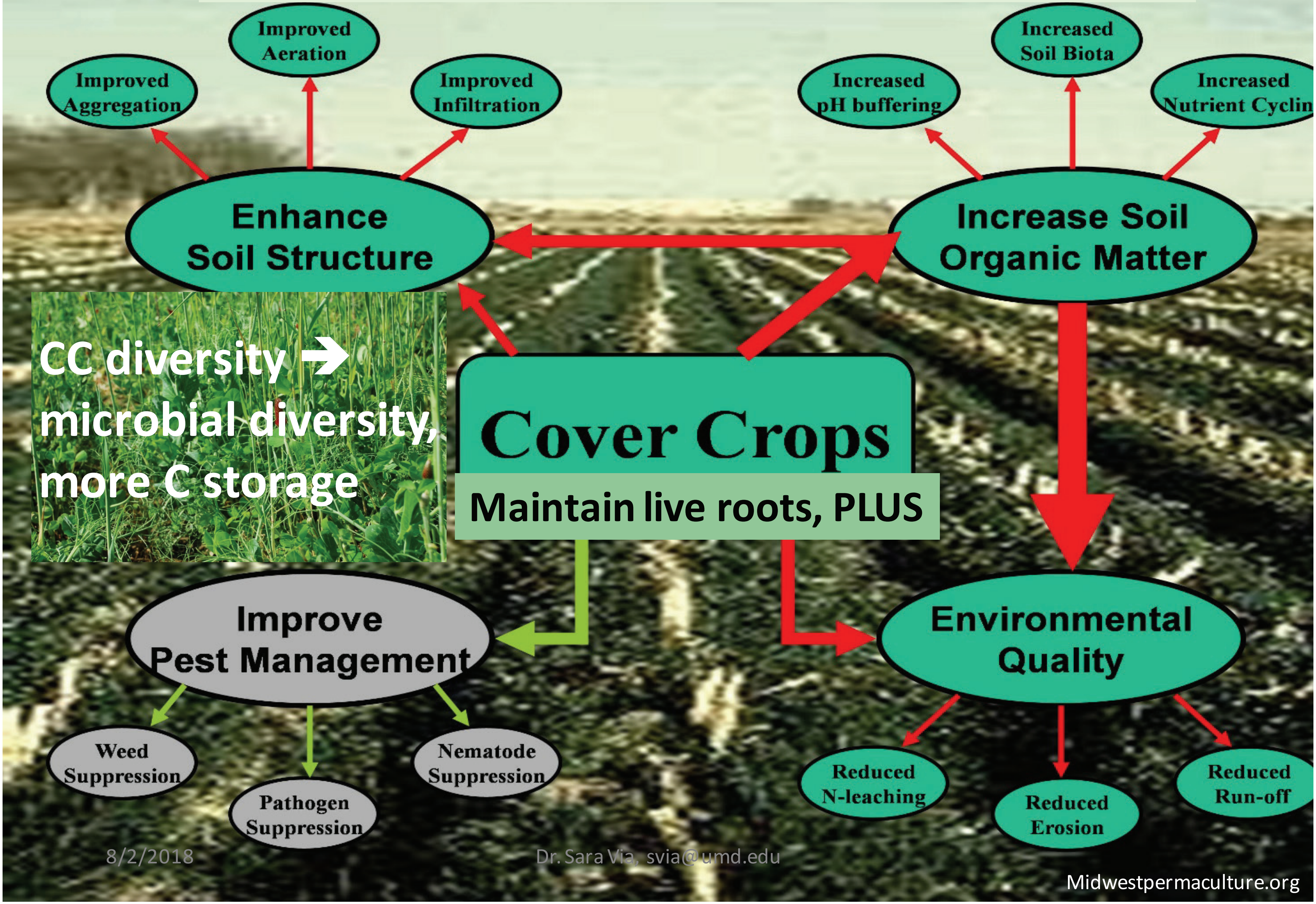
- Economic Benefits of Practices

- Increased soil health worth $40-140/acre
- Allow reduced use of synthetic N, herbicides, pesticides, fuel, irrigation
- Less nitrate in water saves on treatment costs
- Future addition of carbon trading
- Despite short-term yield decline, profits often grow

- Environmental/Health Benefits

- Improved water quality, Bay protection
- Reduced chemical runoff
- Better infiltration, flood reduction
- Reduced erosion, dust, sediment
- Reduction of future climate change

Most practices have multiple co-benefits



Fine-tune the Strategies with MDA, SCDs, UMD Extension Educators & Farmers

- Integrate the practices into current strategies (i.e., rotations, varieties)

- identify ways to increase value of each practice (i.e., make cover crops work harder w/mixtures, interseeding, planting green, use in weed control)

- Outreach to increase farmer acceptance and use (corn/soybeans, boost no-till and cover crops in vegetable and organic farming)

White Paper for MDA, MDE, MCCC

- Summarize practices and GHG reduction potential for 2019 GGRA Plan
- Discuss scientific evidence for the practices
- Consider economic, environmental, and health benefits/costs
- Explore new incentive program that builds on existing NRCS and state incentives
- Identify problems to be solved, i.e., need for additional personnel, increased outreach
- Timeline? How much detail?

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