



Improving Soil Health to Weather The Storm

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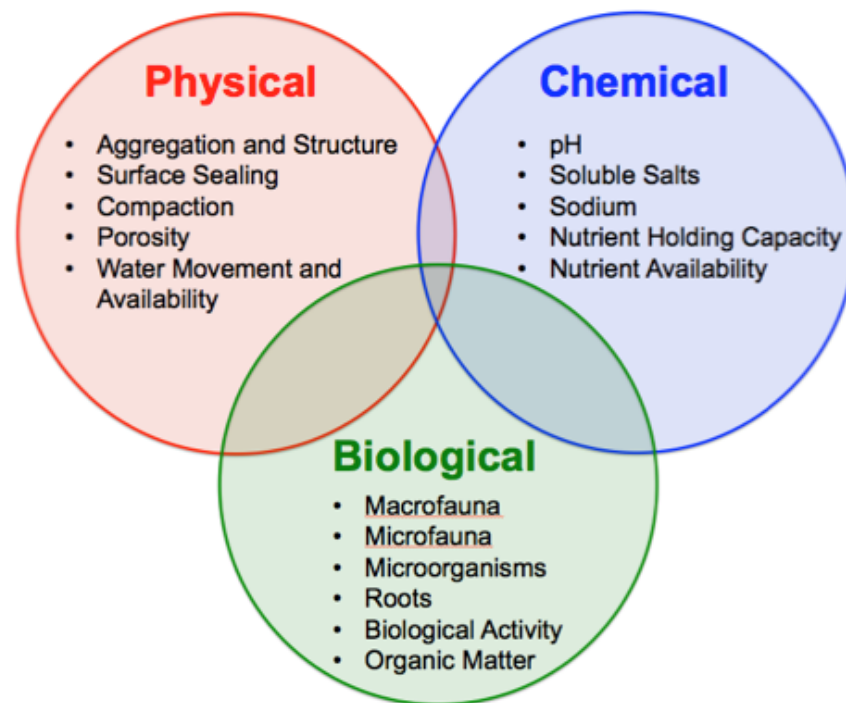
NUTRIENT AND PEST
MANAGEMENT PROGRAM



What is Soil Health?

Definition

...continued capacity of soil to function as a vital living ecosystem that sustains plants, animals, and humans



<https://www.nrcs.usda.gov/wps/portal/nrcs/main/soils/health/>

https://www.ndsu.edu/soilhealth/?page_id=37



Soil Health is Soil Resiliency

Last Year's Lessons

Fields under a soil health management system

- Maintained trafficability and drainage
 - Planted and harvested!!!
- Adequate nutrient cycling
- Maintained yield
- Reduced erosion

2019 USDA-FSA

19.4 million prevent
plant acres nationwide

Largest # of acres since
records began in 2007

592,808 acres in WI

<https://www.fsa.usda.gov/news-room/efoia/electronic-reading-room/frequently-requested-information/crop-acreage-data/index>



TABLE 4. Impact of cover crops on costs, returns and net profit for corn following one, three and five years of cover crop use and with various management scenarios

BUDGET ITEM	YEARS OF COVER CROPPING		
All figures are per acre	One	Three	Five
Estimated input savings when using cover crops			
Fertilizer ¹	\$0	\$14.10	\$21.90
Weed control ²	\$0–\$15	\$10–\$25	\$10–\$25
Erosion repair ³	\$2–\$4	\$2–\$4	\$2–\$4
Subtotal	\$2–\$19	\$26.10–\$43.10	\$33.90–\$50.90
a. Savings on inputs (the low end of the subtotal range from above)	\$2	\$26.10	\$33.90
b. Income from extra yield in normal weather year (survey data) ⁴	\$3.64	\$12.32	\$21
c. Cost of seed and seeding (survey data) ⁵	\$37	\$37	\$37
Net return in a normal weather year (a + b - c)	-\$31.36	\$1.42	\$17.90
Special situations where cover crops can pay off faster			
I. When facing severe herbicide-resistant weeds ⁶	\$27	\$27	\$27
Adjusted net return	-\$4.36	\$28.42	\$44.90
II. Potential grazing income ⁷	\$49.23	\$49.23	\$49.23
Adjusted net return	\$17.87	\$50.65	\$67.13
III. Compaction addressed by cover crops ⁸	\$15.30	\$15.30	\$15.30
Adjusted net return	-\$16.06	\$16.72	\$33.20
IV. Assisting the conversion to no-till from conventional ⁹	\$23.96	\$23.96	\$23.96
Adjusted net return	-\$7.40	\$25.38	\$41.86
V. Income from extra yield in a drought year (survey data) ¹⁰	\$58.70	\$75.73	\$92.55
Adjusted net return	\$27.34	\$77.15	\$110.45
VI. Extra fertilizer savings from improved fertility ¹¹	\$15.20	\$15.20	\$15.20
Adjusted net return	-\$16.16	\$16.62	\$33.10
VII. Federal or state incentive payments received ¹²	\$50	\$50	\$50
Adjusted net return	\$18.64	\$51.42	\$67.90

<https://www.sare.org/Learning-Center/Bulletins/Cover-Crop-Economics>



Improving Soil Health Takes a **SYSTEM**

Not one practice...not one year

- Most emphasized
 - Cover crops
 - No-till
 - Organic amendments
 - Crop rotations
- Less emphasized, just as important
 - Routine soil testing
 - Traffic and equipment management
 - Precision/efficient input management

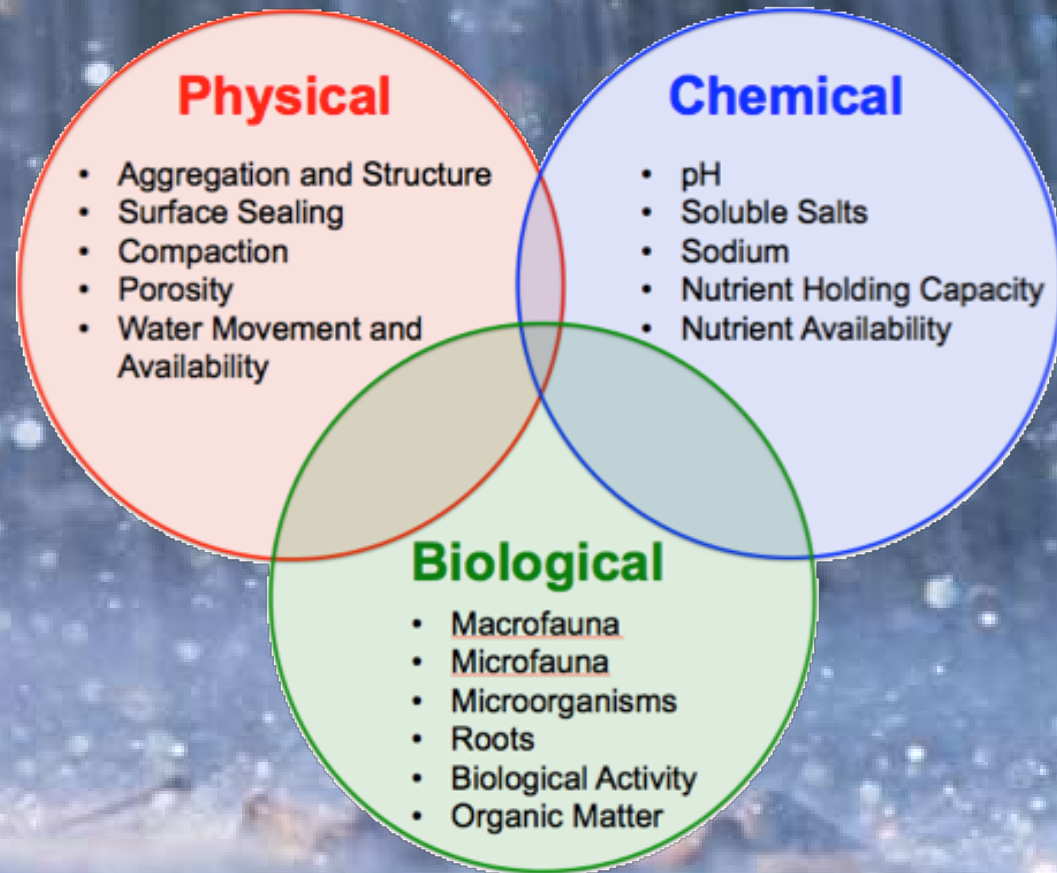


Weathering the Storm

Inseparable processes

Today's focus...

AGGREGATES



Why Soil Aggregates?

Aggregates control pore space

- **Water infiltration**
 - Available water recharge
 - Erosion and runoff
- **Water percolation**
 - Soil aeration/saturation
 - Trafficability
 - Microbial populations
 - Soil chemistry
- **Root growth**
 - Nutrient acquisition
 - Pore space regeneration/stabilization



Why Soil Aggregates?



Why Soil Aggregates?



Why Soil Aggregates?



2015 Infiltration Rates – NE WI



Permanent Vegetation
10.6 in/hr

Corn-Soybeans-Wheat
3.9 in/hr

Aggregates – Protect What You Have



**Compaction can cause
25 to 50% yield loss**

**Increase tillage costs
by 35%**

**Impedes drainage and
trafficability...**



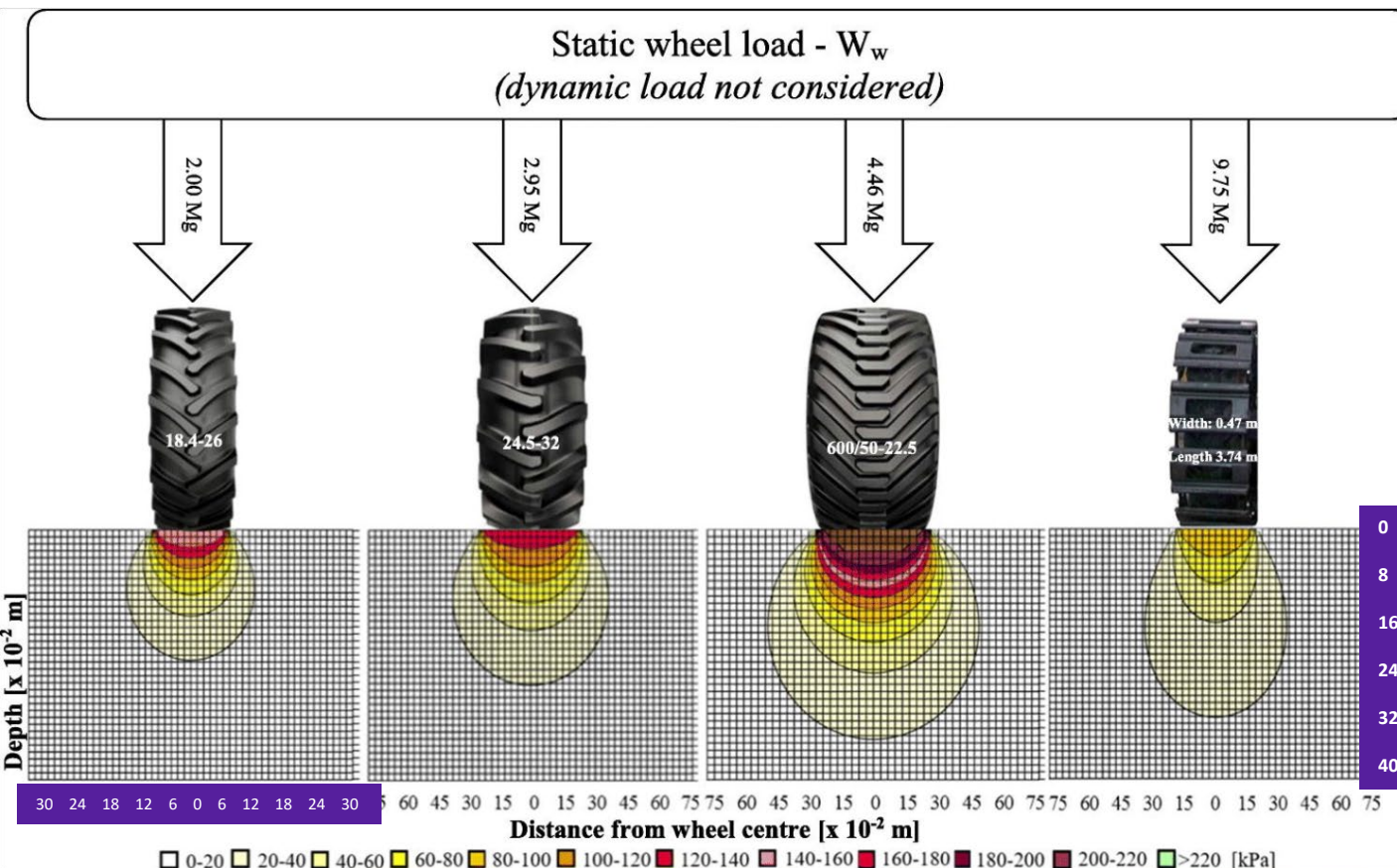
Raghavan, GSV, Alvo, P, and McKyes, E. 1990. Soil Compaction in Agriculture: A View Toward Managing the Problem. In: Advances in Soil Science: Soil Degradation. Lal, R and Stewart, BA, editors. Springer, NY



Aggregates – Protect What You Have

Manage compaction

- Tire size, inflation and axle loads



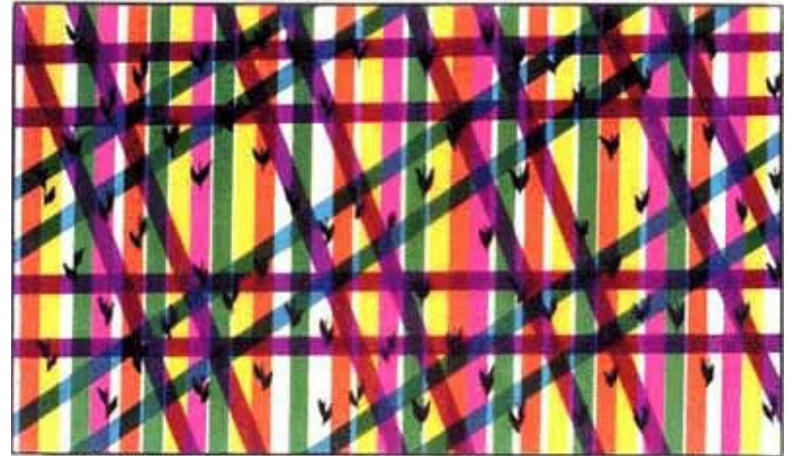
<https://www.sciencedirect.com/science/article/pii/S0048969719320200>



Aggregates – Protect What You Have

Manage compaction

- Wheel alignment, number of equipment passes
- 70 to 90 percent of all compaction occurs on first pass



Illustrates path of:

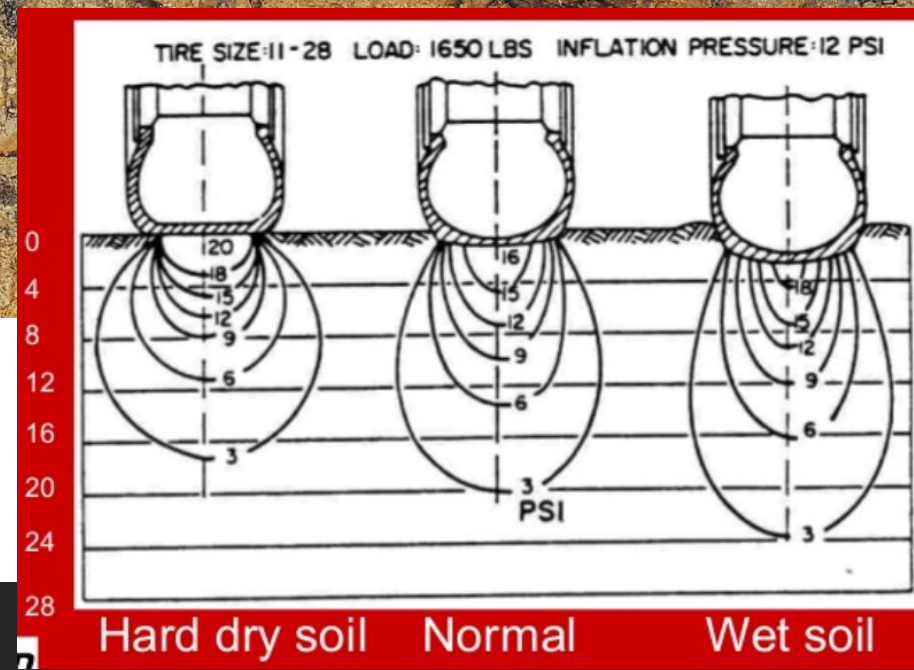
Planter, RC cultivator
Combine

Sprayer

Anhydrous applicator

Tillage
Grain cart





Aggregates – Protect What You Have

Reduce tillage, where possible

- Physically – crushes aggregates
- Biologically and chemically – reduces glues
 - Aerates the soil and increases decomposition of SOM
 - Impacts soil microbial communities

Soil Organic Matter (%)

County	n	Mean	StDev	Median	Max	Min
Brown	45.0	8.2	2.7	7.9	15.5	4.3
Kewaunee	18.0	10.4	5.0	9.4	25.9	4.5
Outagamie	9.0	9.5	5.9	7.8	20.7	3.5
Shawano	35.0	5.8	1.9	5.4	10.1	2.6



Aggregates – Continue to Build

Aggregates are created through

- **Cementation**
 - Organic glues
 - Microbial exudates
 - Soil organic matter
 - Inorganic glues – clays, cations, carbonates
- **Compression**
 - Root growth
 - Macrofauna activity
 - Freeze/thaw and wet/dry



Aggregates – Continue to Build



Aggregates – Continue to Build

Diversity of roots and root exudates

- **Cover crops**
 - Fibrous and taproots
 - Warm/cool season, grasses, legumes, broadleaves
 - Planted early as possible, ideally overwinter
 - Interseeding
 - Other benefits – mulch, pollinators, pest control
- **Rotations**
 - Different plant families, root systems
 - Eliminate fallow, if possible





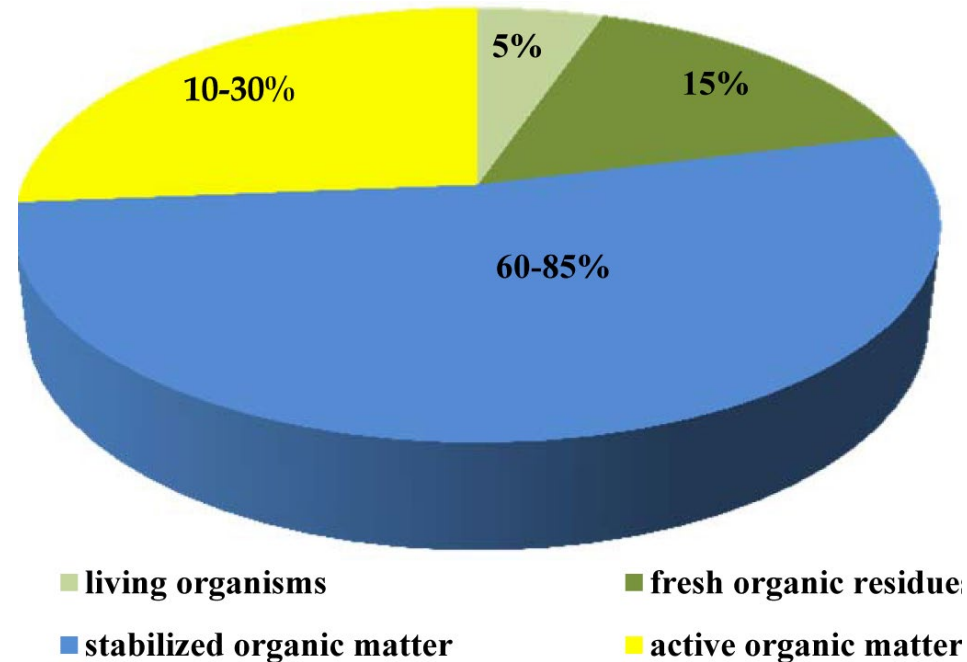
Aggregates – Continue to Build

Organic additions

- Composts
- Manures
- Green manures

Measurable SOM increases take time

- Goal???
- 0.1% per year??



Weathering the Storm

Resiliency requires

Planning

Long-term Investment

Management System

**Too much rain, too little rain...
same concepts apply**



We NEED Resiliency





Questions?

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