

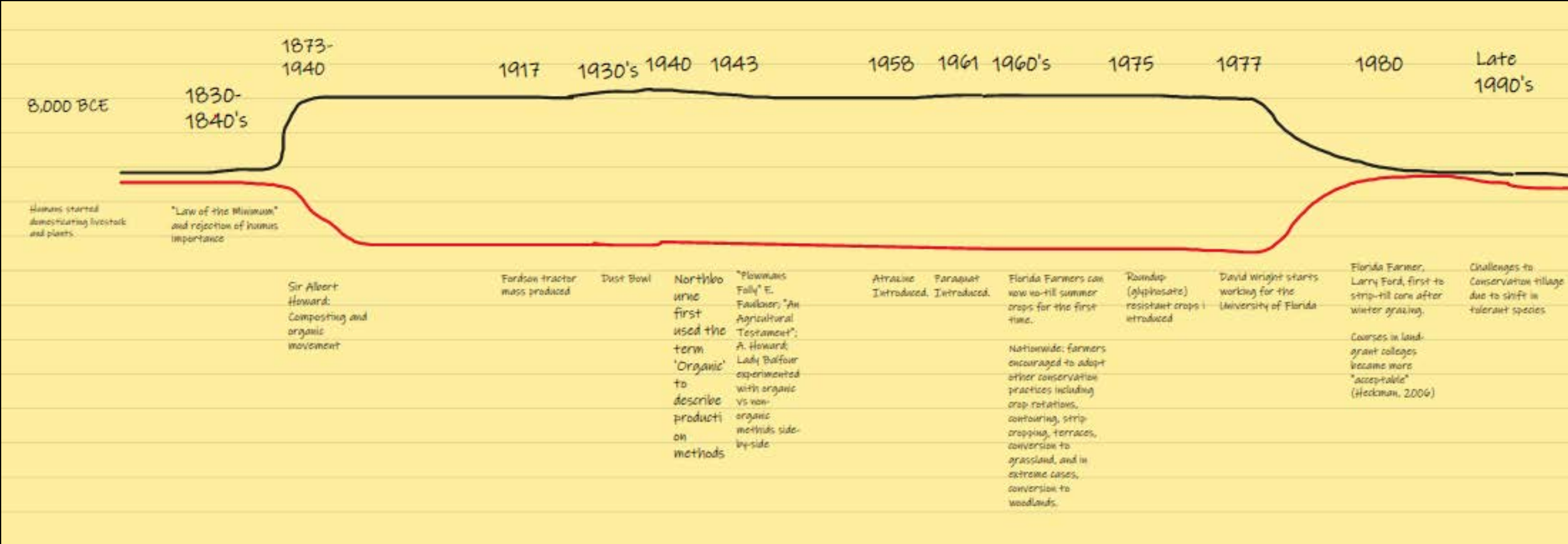
The Road to Regenerative Agriculture

Danielle Treadwell and David Campbell
UF/IFAS Department of Horticultural Sciences

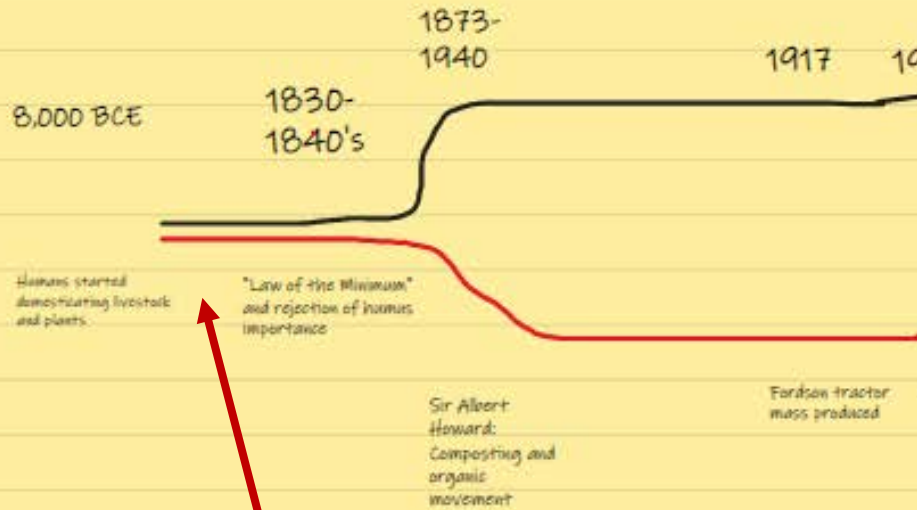
David Wright Symposium
October 14, 2022



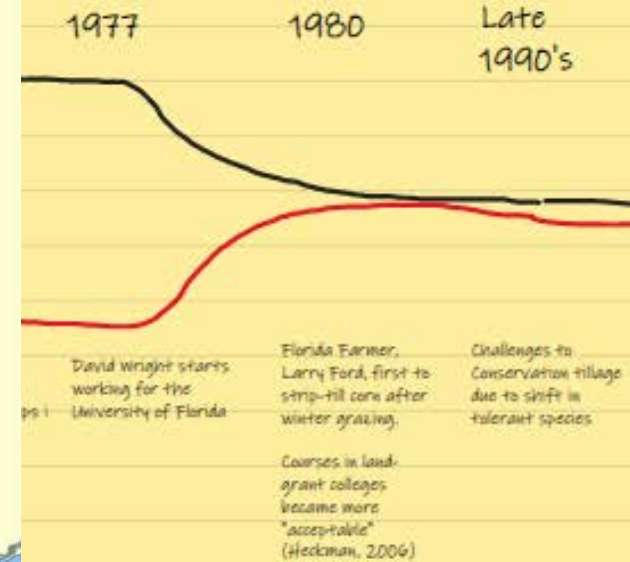
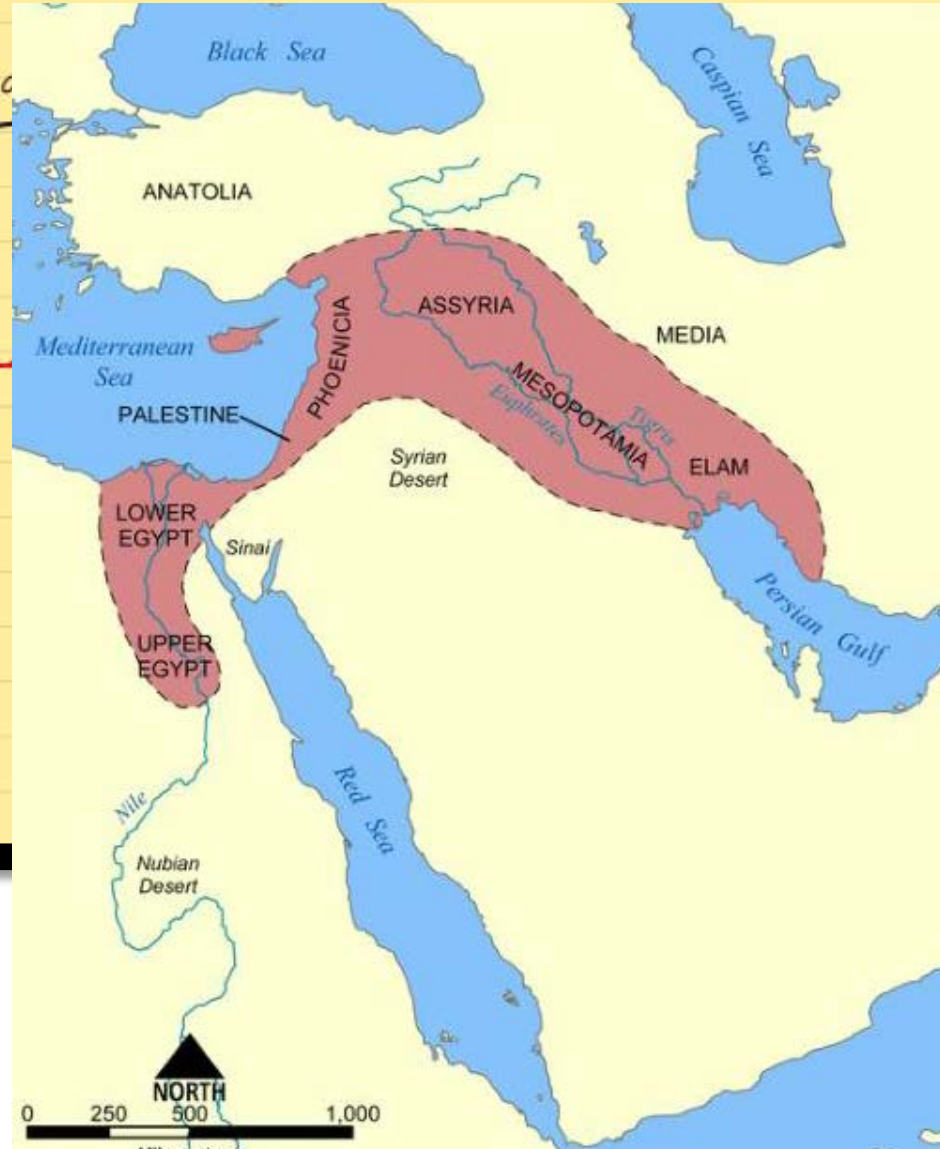
A Brief History of (Ag) Time



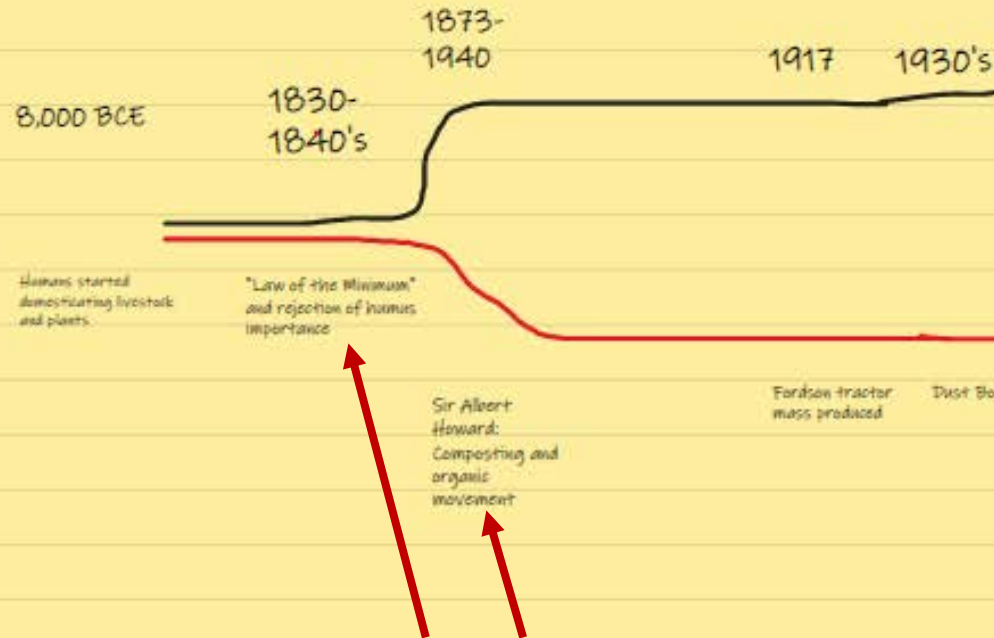
A Brief History of (Ag) Time



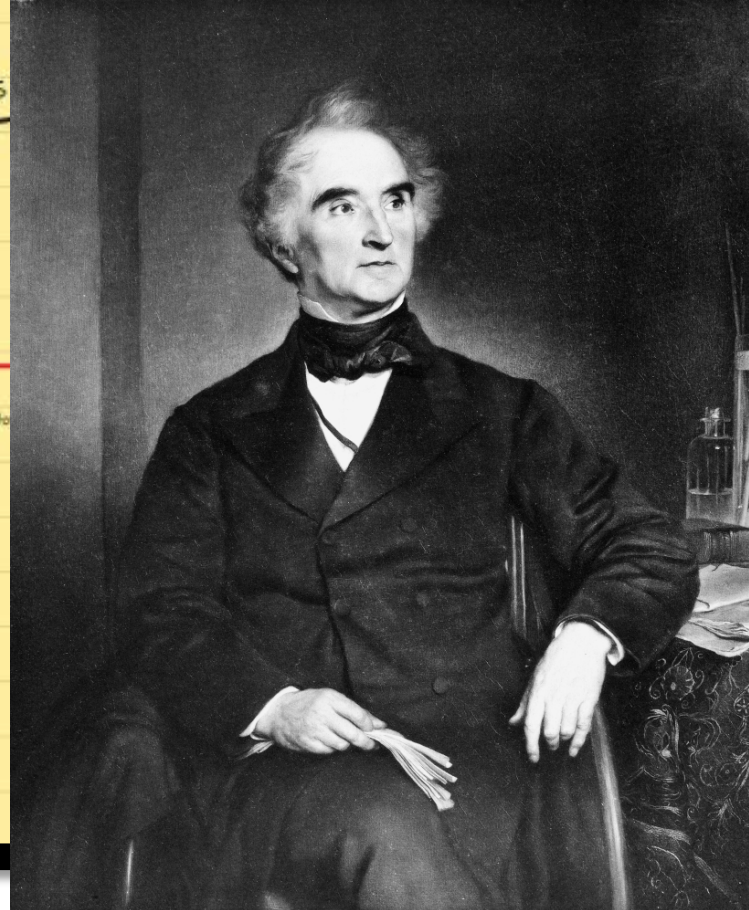
10,000 Years Ago
Humans started to put down roots. This was the beginning of the domestication of plants and animals, and the beginning of our journey.



A Brief History of (Ag) Time



In the early 1800's and 1900's two scientists, Liebig and Howard, published their findings in what would become the foundation of divergent views – two different philosophies of nutrient management.

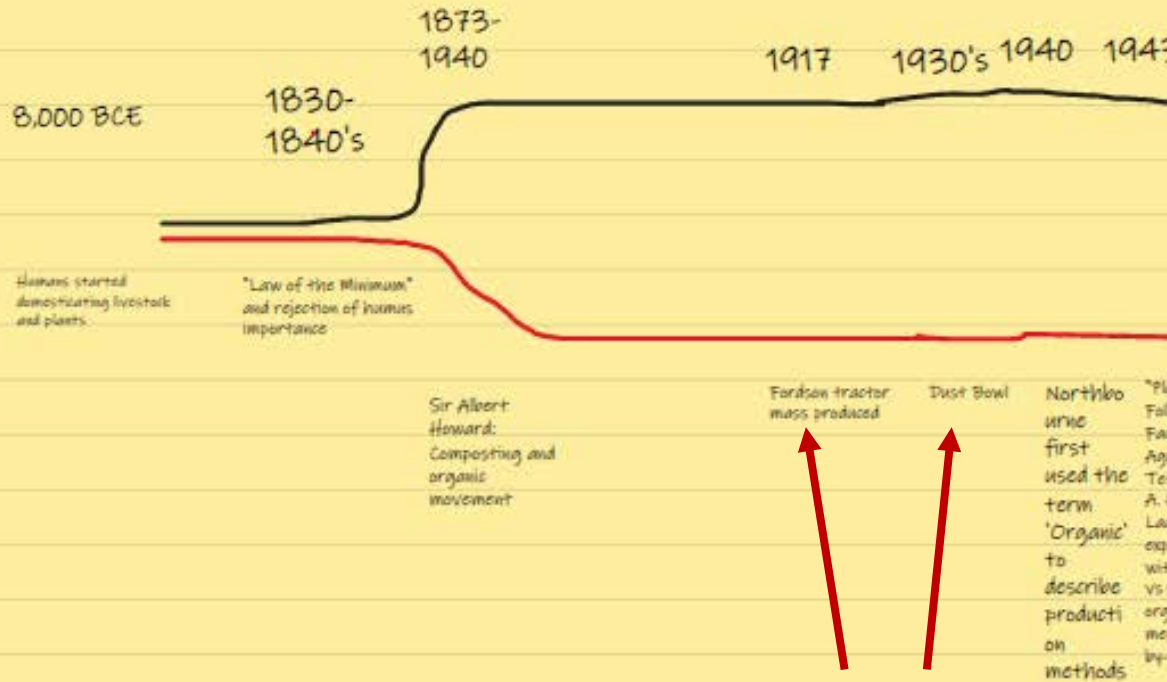


Justus Von Liebig



Sir Albert Howard

A Brief History of (Ag) Time



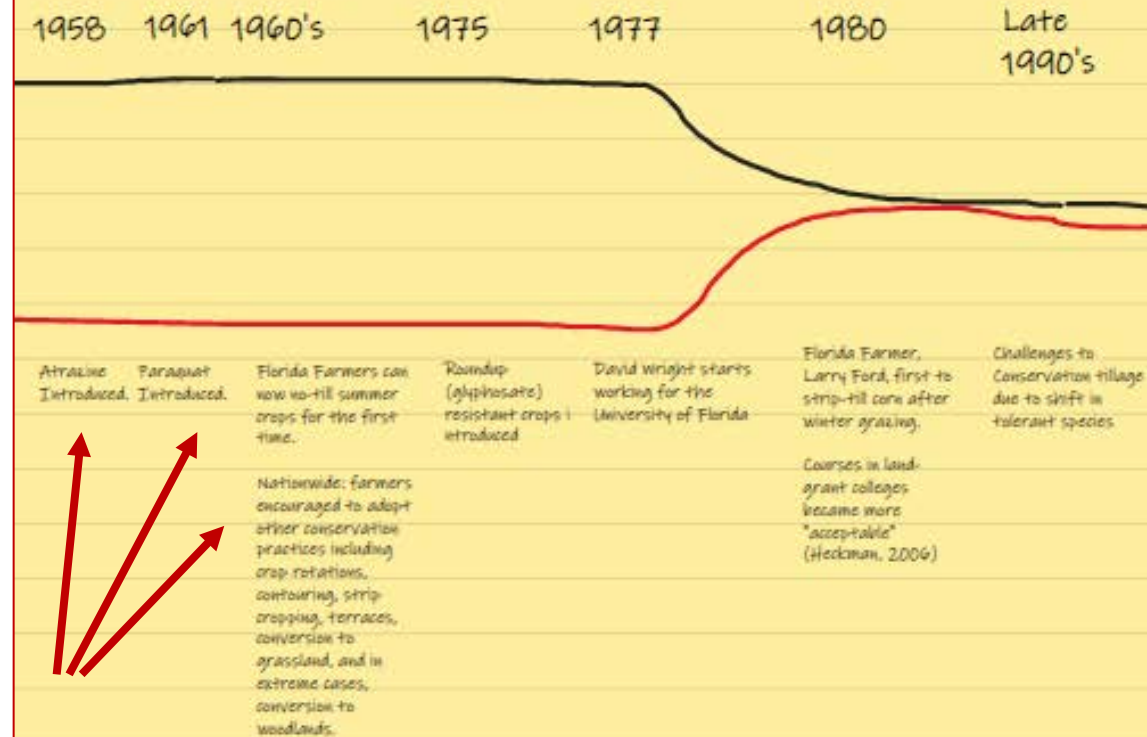
In the 1930's, the advent of tillage due to the mass production of steel tools and the tractor collided with drought conditions in the Great Plains. In the wake of significant soil and economic loss, Roosevelt established the civilian conservation core and the soil erosion service, later these would become NRCS.

of disaster, and in extreme cases, conversion to woodlands.

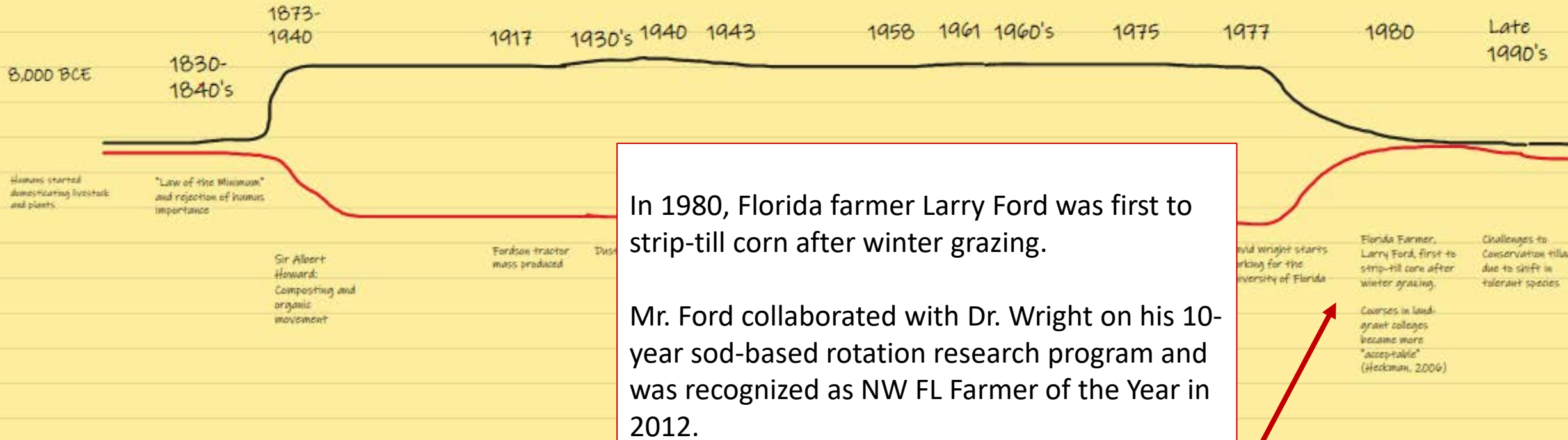
A Brief History of (Ag) Time

In the 1950's and 1960's, the ag industry expanded, and farms became more efficient. Mechanization replaced labor, and improved spray rigs applying Atrazine and Paraquat were integrated into cropping systems. Florida farmers could now no-till summer cover crops for the first time.

By the '70's, conservation practices including no-tilling were supported by the release of glyphosate-resistant crops, and improved equipment such as Brown Manufacturing's strip till unit. Use of chemical pesticides was one driver of the organic agriculture movement.



A Brief History of (Ag) Time



Flashback to 1977



1st Space Shuttle Enterprise Test Flight

Fashion was questionable



The Apple II

Food and Agriculture Act of 1977 (P.L. 95-113)



Nebraska Tractorcade 1977 – Farm Strike

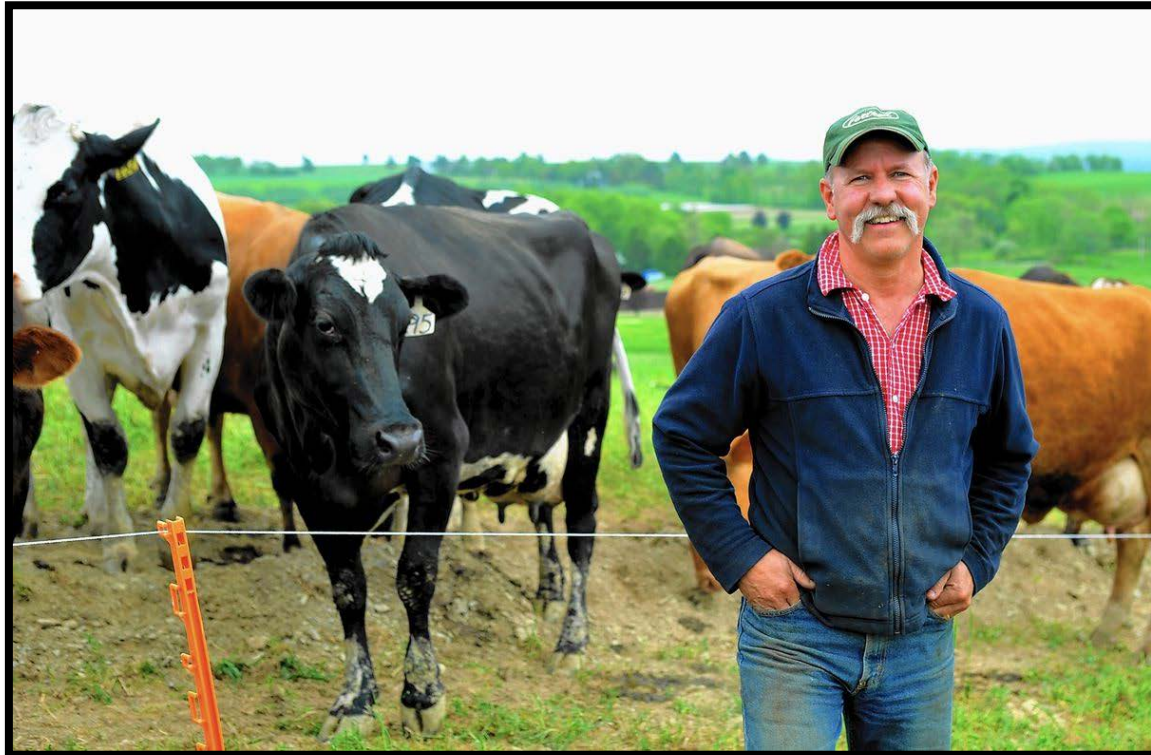
Photo Credits: www.gosanangelo.com/

Alternative Agriculture

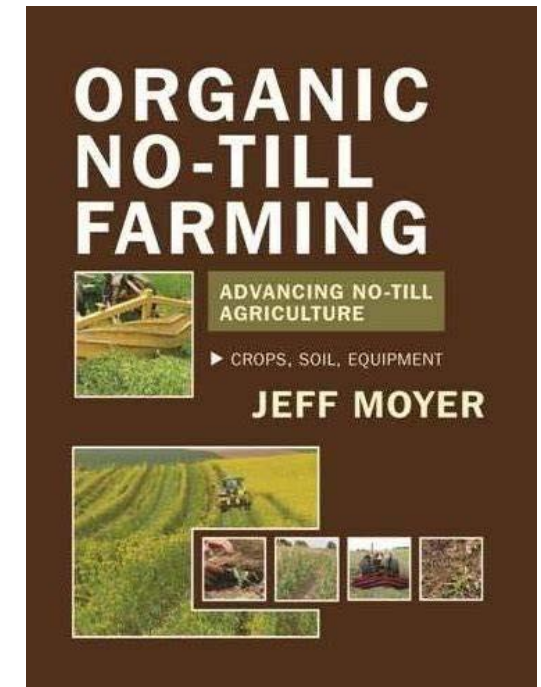
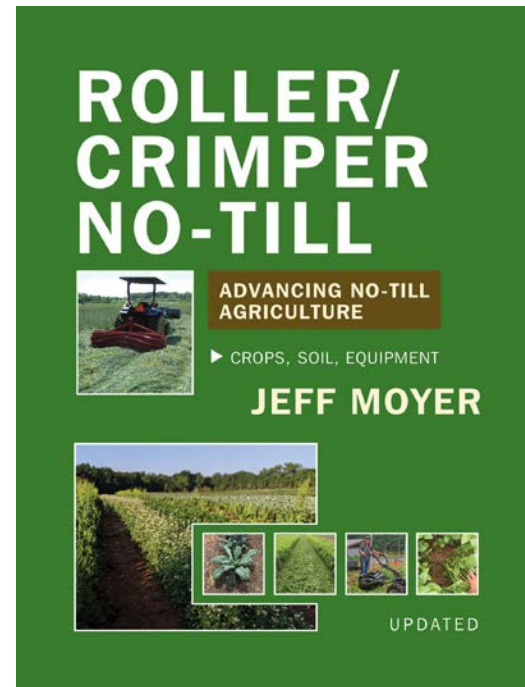
“The hallmark of an alternative farming approach is not the conventional practices it rejects but the innovative practices it includes.” -*National Research Council, Alternative Agriculture (1989)*



Rodale and Acres USA Gave Clear Directions



“I have great memories of eating boiled peanuts with David while throwing food into his pond to feed the alligator!”
- Jeff Moyer



USDA's National Organic Program

- Certified Organic farming systems are the only farming systems in the United States that
 - are REQUIRED by federal regulation to use an integrated package of management practices that maintain or improve the natural resources of the farm, including soil and water quality,
 - are REQUIRED to use preventative management practices to manage pests, and
 - are REQUIRED to undergo a rigorous annual oversight and certification process.

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Countries/Territories

ESI Top Papers

Sort by: Times Cited - highest to lowest | Page 1 of 2,756

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Citation Report feature not available [?]

1. **Botanical insecticides, deterrents, and repellents in modern agriculture and an increasingly regulated world**
By: Isman, MB
ANNUAL REVIEW OF ENTOMOLOGY Book Series: Annual Review of Entomology Volume: 51 Pages: 45-66 Published: 2006
Times Cited: 1,021 (from All Databases)
Highly Cited Paper
Usage Count
2. **Soil fertility and biodiversity in organic farming**
By: Mader, P, Fliesbach, A, Dubois, D, et al
SCIENCE Volume: 296 Issue: 5573 Pages: 1694-1697 Published: MAY 31 2002
Times Cited: 834 (from All Databases)
Usage Count
3. **The ecological role of biodiversity in agroecosystems**
By: Altieri, MA
AGRICULTURE ECOSYSTEMS & ENVIRONMENT Volume: 74 Issue: 1-3 Pages: 19-31 Published: JUN 1999
Times Cited: 696 (from All Databases)
Usage Count
4. **Crop pollination from native bees at risk from agricultural intensification**
By: Kremen, C, Williams, NM, Thorp, RW
PROCEEDINGS OF THE NATIONAL ACADEMY OF SCIENCES OF THE UNITED STATES OF AMERICA Volume: 99 Issue: 26 Pages: 16812-16816 Published: DEC 24 2002
Times Cited: 549 (from All Databases)
Usage Count
5. **Determinants of soil microbial communities: Effects of agricultural management, season, and soil type on phospholipid fatty acid profiles**
By: Bossio, DA, Scow, KM, Gunapala, N, et al
MICROBIAL ECOLOGY Volume: 36 Issue: 1 Pages: 1-12 Published: JUL-AUG 1998
Times Cited: 522 (from All Databases)
Usage Count
6. **Does organic farming benefit biodiversity?**
By: Hole, DG, Perkins, AJ, Wilson, JD, et al
BIOLOGICAL CONSERVATION Volume: 122 Issue: 1 Pages: 113-130 Published: MAR 2005
Times Cited: 509 (from All Databases)
Highly Cited Paper
Usage Count
7. **The effects of organic agriculture on biodiversity and abundance: a meta-analysis**
By: Bengtsson, J, Ahnstrom, J, Weibull, AC
JOURNAL OF APPLIED ECOLOGY Volume: 42 Issue: 2 Pages: 261-269 Published: APR 2005
Times Cited: 503 (from All Databases)
Highly Cited Paper
Usage Count
8. **Bacterial and fungal contributions to carbon sequestration in agroecosystems**
By: Six, J, Frey, SD, Thiet, RK, et al
SOIL SCIENCE SOCIETY OF AMERICA JOURNAL Volume: 70 Issue: 2 Pages: 555-569 Published: MAR-APR 2006
Times Cited: 429 (from All Databases)
Highly Cited Paper
Usage Count
9. **Comparison of the total phenolic and ascorbic acid content of freeze-dried and air-dried marionberry, strawberry, and corn grown using conventional, organic, and sustainable agricultural practices**
By: Asami, DK, Hong, YJ, Barrett, DM, et al
JOURNAL OF AGRICULTURAL AND FOOD CHEMISTRY Volume: 51 Issue: 5 Pages: 1211-1211 Published: FEB 26 2003
Times Cited: 395 (from All Databases)
Usage Count
10. **Carbon sequestration in the agricultural soils of Europe**
By: Freibauer, A, Rounsevell, MDA, Smith, P, et al
GEODERMA Volume: 122 Issue: 1 Pages: 1-23 Published: SEP 2004
Times Cited: 384 (from All Databases)
Usage Count

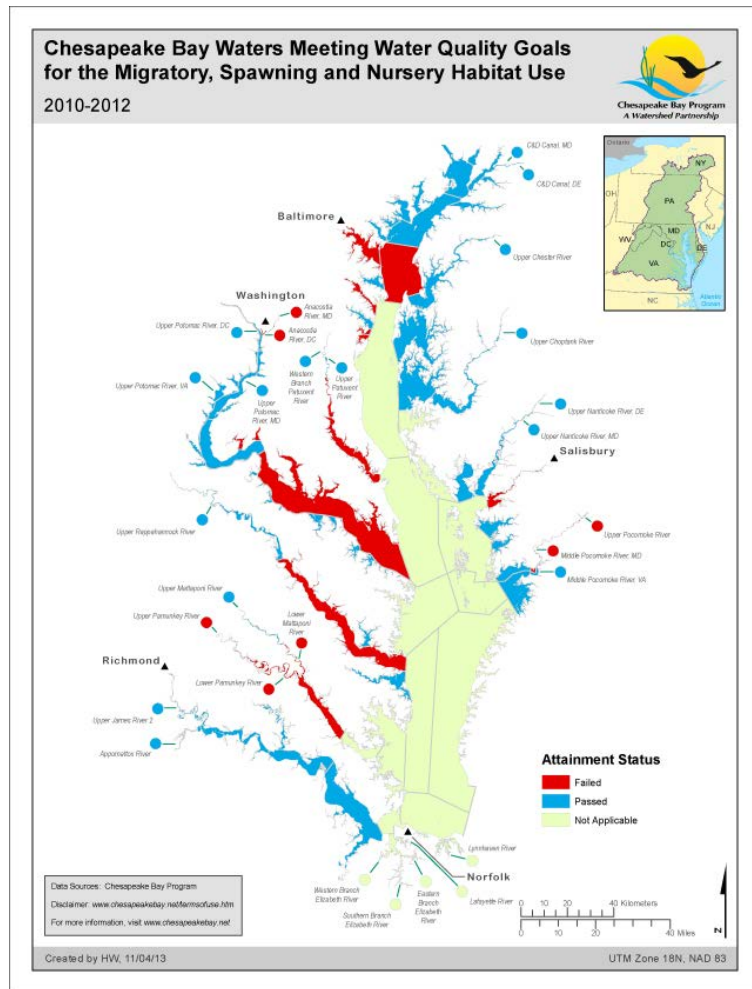
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Science Explains Organic Systems

- This is a screen shot of the top 10 research articles with the greatest number of citations.
- Each article is from a different peer-reviewed journal.
- 66 new citations Jan 1 2016 – Feb 24 2016 “organic farm*” Web of Science; 27,557 citations in all.

Federal/State Programs That Include the National Organic Program



- National Organic Program
- NRCS Conservation Programs
- Federal Food Safety
- Commodity Marketing Orders
- Chesapeake Bay Cover Crop Practice Standard
- FL Dept. Agriculture and Consumer Services BMPs

Florida Agricultural Land Use changes between 2012 and 2017

Farm Size	Cropland with Intensive Tillage		Cropland with no-till		Cropland with reduced tillage, excluding no-till		Cropland with a cover crop (excluding CRP)		Land under conservation easement	
	Farms	Acres	Farms	Acres	Farms	Acres	Farms	Acres	Farms	Acres
1 to 9	67%	72%	177%	204%	56%	78%	166%	n/a	104%	105%
10 to 49	83%	88%	141%	150%	92%	87%	109%	103%	89%	79%
50 to 99	66%	65%	145%	137%	90%	99%	107%	104%	88%	94%
100 to 199	88%	87%	185%	183%	95%	98%	122%	118%	131%	129%
200 to 499	82%	85%	164%	156%	135%	144%	80%	77%	138%	136%
500 to 999	91%	92%	80%	83%	174%	178%	77%	88%	116%	130%
1,000 to 1,999	90%	91%	75%	81%	200%	204%	104%	103%	82%	91%
2,000 +	88%	89%	130%	149%	229%	250%	300%	n/a	125%	153%
All	75%	88%	159%	127%	79%	173%	127%	103%	103%	132%

Total in 2017 **2,729** **802,923** **2,077** **244,994** **870** **189,212** **1,573** **141,848** **1,022** **297,900**

Source: 2017 USDA Ag Census

Note: Highlighted data indicate an increase. Census data prior to 2012 combines all conservation practices such as wetland reserve, easements, etc.

Let's Create the System

“Cover crops to me are just the next natural step in trying to have a broader system, and I think the single biggest issue we have as farmers in this country is we don't farm with a system in mind.”

- panelist Howard G. Buffett, a philanthropist and Illinois farmer.



National Cover Crop Conference, 2014

NRCS Supported Integration of Organic & Conventional Approaches



USDA – Natural Resource Conservation Service (NRCS) Growing Organic video series, available at:

<https://www.nrcs.usda.gov/wps/portal/nrcs/main/national/organic/>

unlock the SECRETS IN THE SOIL

PRINCIPLES FOR HIGH FUNCTIONING SOILS

SOIL HEALTH DEFINED

Soil health is the **continued capacity of a soil to function as a vital, living ecosystem that sustains plants, animals, and humans.** Only living things can have "health," so viewing soil as a living, breathing ecosystem reflects a shift in the way we view and manage our nation's soils. Soil isn't an inert growing medium, but rather is the home of billions of bacteria, fungi, and other organisms that together create an intricate symbiotic ecosystem. This ecosystem can be managed to support plants and animals, by cycling nutrients, absorbing, draining and retaining rainwater and snowmelt for use during dry periods, filtering and buffering water to remove potential pollutants, and providing habitat for the soil biological population to flourish and diversify to keep the ecosystem functioning well.

KEY SOIL HEALTH MANAGEMENT PRINCIPLES

These principles are represented in the circular diagram to the left to emphasize their relationship as a continuum where each complements the others and also depends on the others.

1. Minimize disturbance
2. Maximize soil cover
3. Maximize biodiversity
4. Maximize presence of living roots

PROTECTING THE SOIL HABITAT

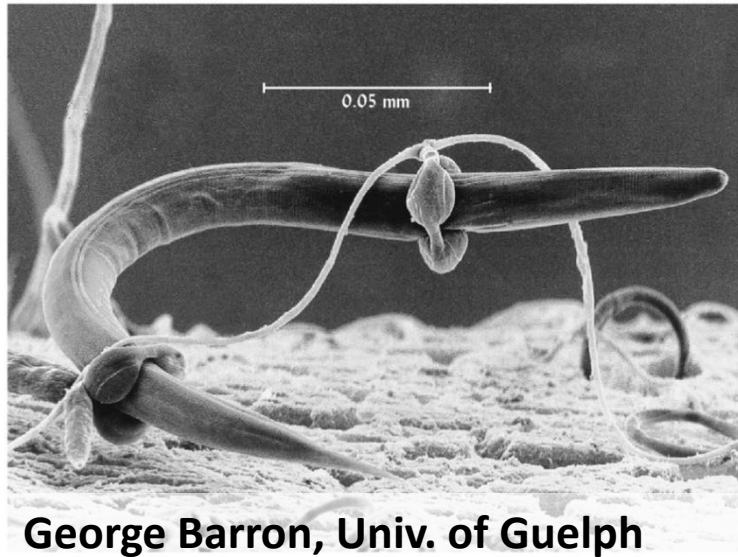
The first two principles, shown on the right side of the diagram above focus on protection of the soil habitat: minimize disturbance and maximize soil cover. Practices that use these principles maintain or increase stable soil aggregates and soil organic matter (SOM), and protect the surface of the soil that is most susceptible to the degrading forces of wind and water. Maximizing soil cover also buffers against temperature fluctuations that stress plants and soil organisms, reduces evaporation rates, and increases the amount of water entering the soil profile from precipitation and irrigation.

FOUR SOIL HEALTH PRINCIPLES

Maximize Presence of Living Roots, Minimize Disturbance, Maximize Soil Cover, Maximize Biodiversity

USDA United States Department of Agriculture

USDA is an equal opportunity provider, employer, and lender.



George Barron, Univ. of Guelph



Debbie Roos, NCSU



Marie Newman, NCSU



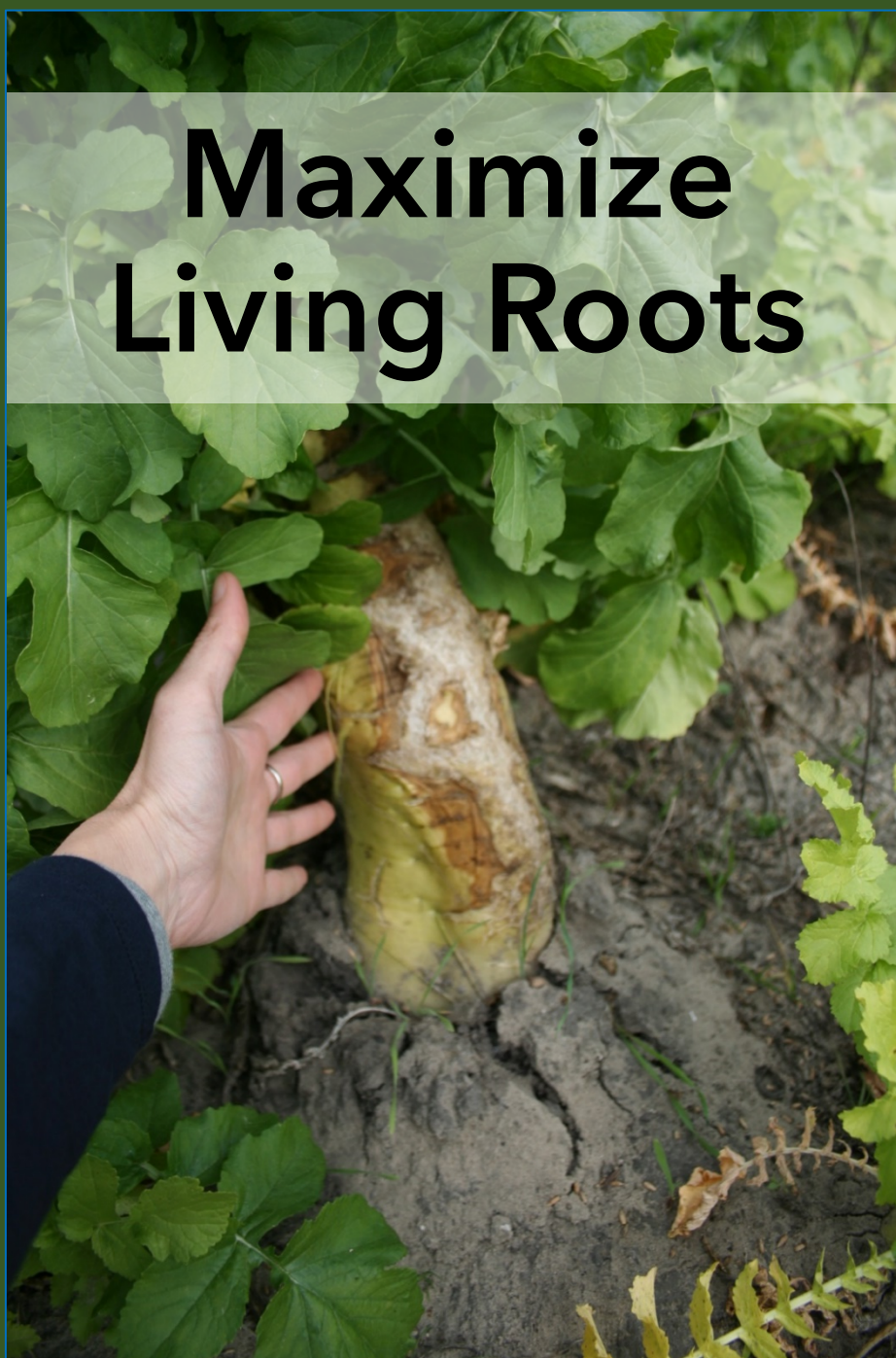
W.J. Hickey, Univ. Wisconsin

Restore Biodiversity



Minimize Soil Disturbance





Maximize Living Roots



LIVE OAK, FL, USA, 2013



UZBEKISTAN, 2022



AMF on corn root with hyphae and spores.
Green dye indicates glycoprotein production
Muruganandam, 2005

Retain Residue



MANY THANKS TO DAVID WRIGHT!

- Designer/brains behind the Integrated Crop-Livestock System
- A true champion of sustainable systems
- Supporter of no-till organic before it was cool
- Always there to bounce ideas off of – no matter how crazy
- Consistently positive and happy to see you!



Kathleen Delate, Professor, Iowa State University

USDA-NIFA-ORG experiment showed viable no-till vegetable yields with superior soil quality

Tomato yields:

- 25 tons/acre in organic Tilled system
- 24 tons/acre in organic No-Tilled system



Mulched onions

No-till tomatoes

Tilled tomatoes



Rodale roller/crimper

Integrating livestock with crops: our OREI grant findings



- ✓ Enhances nutrient cycling
- ✓ Preserves soil carbon with year-round plant cover
- ✓ Grazed wheat and rye pastures having a greater amount of the soil enzyme, glucosidase, and greater soil nitrate levels to support row crops in the rotation







—Galindo, F.S., Delate, K., Heins, B., Phillips, H., Smith, A., and Pagliari, P.H. 2020. Cropping System and Rotational Grazing Effects on Soil Fertility and Enzymatic Activity in an Integrated Organic Crop-Livestock System. *Agronomy* 10: 803: <https://www.mdpi.com/2073-4395/10/6/803>



Cover Crop Innovators Series

SARE Outreach - 14 / 24



- ▶  **Stephen Fulford - Monticello, Florida**
SARE Outreach 3:11
- 15  **Noah Shitama - Alachua, Florida**
SARE Outreach 2:56
- 16  **Kirk Brock - Monticello, Florida**
SARE Outreach 2:52
- 17  **Jordan Brown - Gainesville, Florida**
SARE Outreach 3:32
- 18  **John Bitter - Hawthorne, Florida**
SARE Outreach 3:52
- 19  **Cody Galligan - Gainesville, Florida**
SARE Outreach 2:31

Stephen Fulford - Monticello, Florida

3,582 views

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SARE Outreach
Published on Jul 22, 2016

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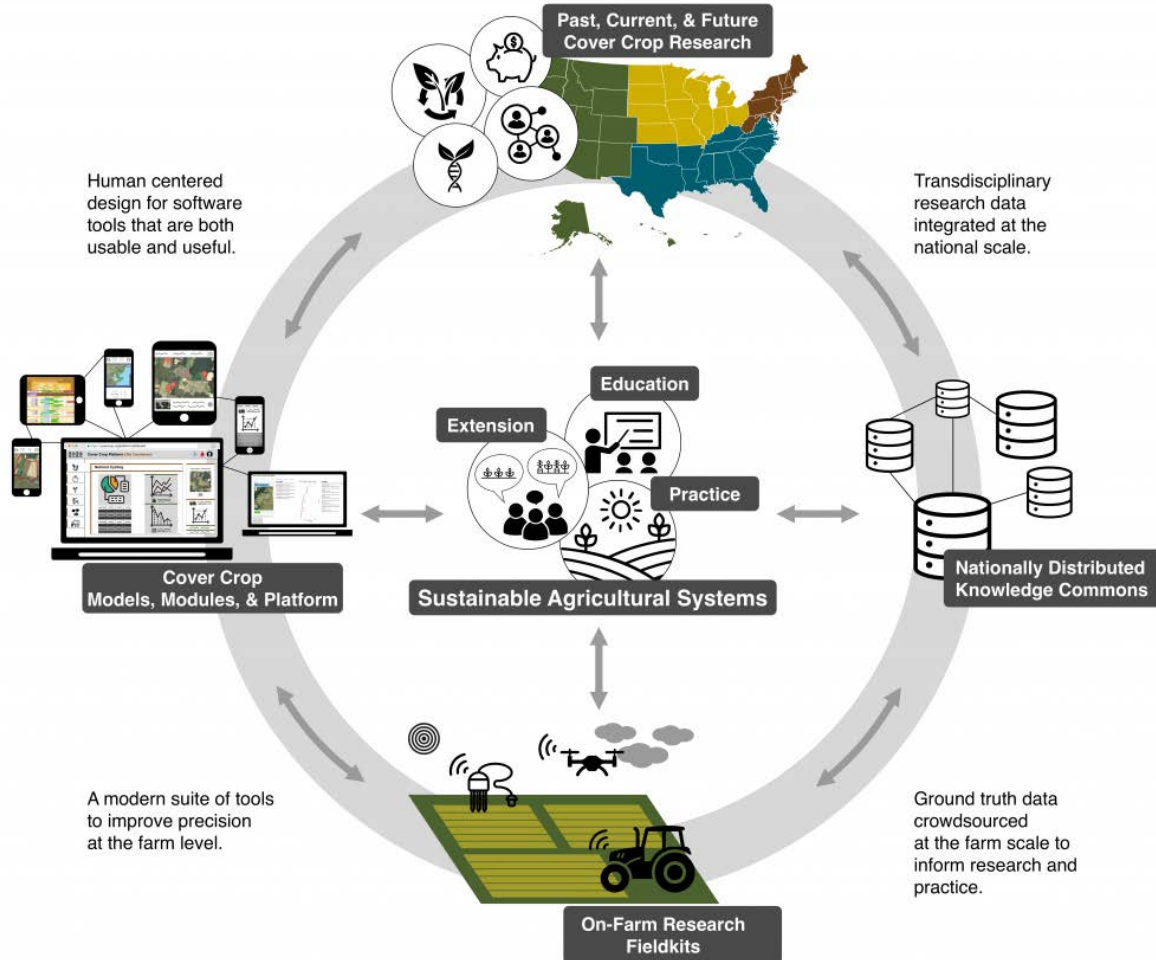
Jim Hershey - Elizabethtown, Pennsylvania
SARE Outreach
2.8K views



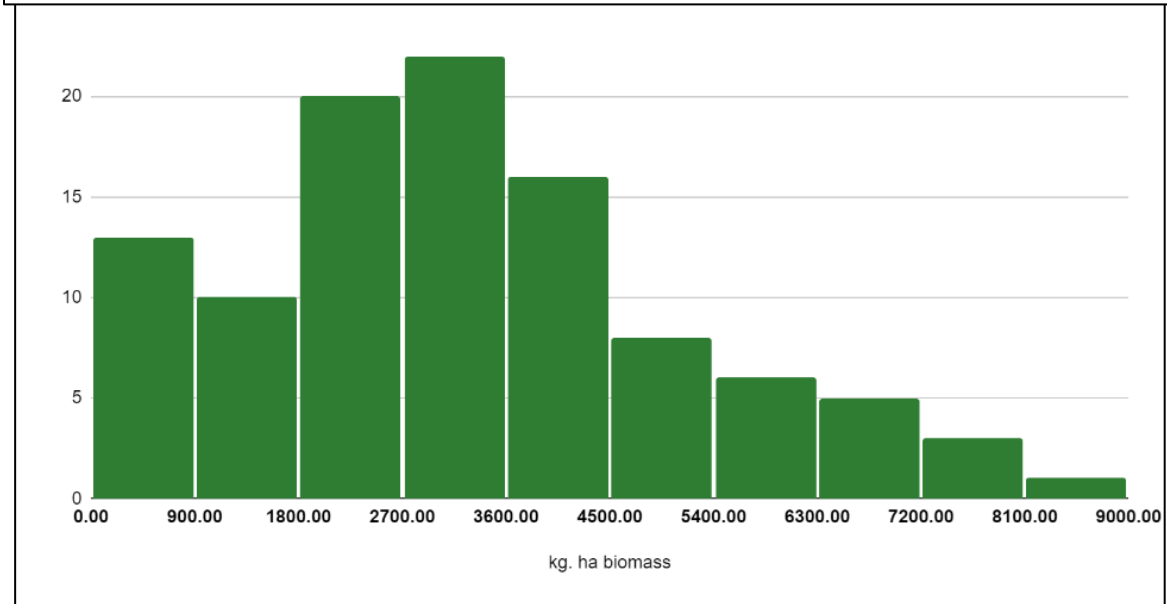
Under Cover Farmers - Feature Length

Networks of Networks to Increase Adoption and Improve Cover Crop Management

An Information Ecology for Sustainable Agriculture



PSA preliminary data illustrating the distribution of cover crop biomass (dry weight) – 52/100+ sites in 2021. Mean biomass was 3,300 kg/ha or 3,696 lb/a.



PSA: <https://precisionsustainableag.org/about-us/>

