

# Alternative Cropping System in the Midwest: A Study Case using Dry Edible Beans

### Jean Bertrand Contina<sup>1</sup>, Ph.D. and Reza Keshavarz Afshar<sup>2</sup>, Ph.D.

<sup>1</sup>RI-MOC Research Director; <sup>2</sup>Rodale Institute Chief Scientist jean.contina@rodaleinstitute.org; reza.afshar@rodaleinstitute.org

# **RODALE MIDWEST ORGANIC CENTER**

AT ETZEL SUGAR GROVE FARM



# Our story:

- Founded in 1947 by Jerome I. Rodale in Kutztown, PA.
- Formerly known as the "Soil & Health Foundation".
- Inspired by Sir Albert Howard (early founders of organic movement).
- Created the 'Organic Gardening and Farming' magazine
- Popularized the term "organic" in the U.S.
- Regional Resource Centers:
  - California, Iowa, Georgia, Oregon, Pennsylvania, and Italy
- Research
- Organic Consulting
- Education

### Healthy Soil = Healthy Food = Healthy People



### Main campus: Kutztown, PA





# **Farming Systems Trial**



### **Conventional Synthetic**

This system represents a typical U.S. grain farm. It relies on synthetic nitrogen for fertility, and weeds are controlled by synthetic herbicides selected and applied at rates recommended by Penn State University Cooperative Extension.



### **Organic Legume**

This system represents an organic cash grain system. It features a mid-length rotation consisting of annual grain crops and cover crops. The system's sole source of fertility is leguminous cover crops, and crop rotation provides the primary line of defense against pests.



### **Organic Manure**

This system represents a diversified organic dairy or beef operation that includes a long rotation of annual feed grain crops and perennial forage crops. Fertility is provided by leguminous cover crops and periodic applications of composted manure from livestock. A diverse crop rotation is the primary line of defense against pests.







# Farming Systems Trial: Results and Conclusions

ORGANIC PRACTICES INCREASE SOIL ORI MATTER MICROBIAL BIOMASS, DIVERSITY, A WHILE REDUCING SOIL COMPACTION	GANIC IND ACTIVITY DN.	<b>30% HIGHER</b> <b>YIELDS</b> DURING TIMES OF EXTREME WEATHER.	ORGANIC YIELDS MATCH CONVENTIONAL YIELDS FOR CASH CROPS, SUCH AS CORN AND SOYBEAN.
ORGANIC MANAGEMENT INCREASES WATER INFILTRATION AND DOES NOT CONTRIBUTE TO THE ACCUMULATION OF TOXINS IN WATERWAYS.	EVEN WITHOU ORGANIC CRO THE ORG SYSTEM PROFITA	T THE PREMIUMS PAID FOR PS, ANIC MANURE IS THE MOST BLE SYSTEM	ORGANIC SYSTEM OPERATION COST IS SIGNIFICANTLY LOWER THAN CONVENTIONAL MANAGEMENT.

# Farming Systems Trial: Results and Conclusions

# **Benefits of healthy soil**

- Increase soil organic matter
- Increase soil organic carbon
- Increase microbial population
  - N-fixing bacteria
  - Biocontrol microbes
- Increase the availability of soil nutrients
- Improve soil physical properties
  - Water content
  - Aggregate stability
  - Erosion prevention



Sylvia et al. 2005. Principles & Applications of Soil Microbiology

### Soil aggregates

- Mineral soil particles
- Organic matter
- Water
- Plant root
- Soil organisms
  - Fungi
  - Bacteria
  - Nematodes



### **Midwest Organic Center (MOC):**

- Rodale Institute's pioneer Regional Resource Center.
- Long-term agronomic research & education hub to help farmers.

### **MOC's priorities for the Midwest:**

- Help organic and transitioning farmers be successful.
- Improve soil health and ecosystem productivity.
- Improve water quality within local and regional watersheds.
- Restore rural communities by supporting local farmers and local foodsheds.
- Increase biodiversity.
- Mitigate and adapt to climate change by sequestering carbon and modeling diversified, resilient farming practices.













### **Plant hardiness zone**



### 120B: Tama silty clay loam, 2 to 5 percent slopes (408535)



### Muscatine (5%) Wet Loess Upland Flat Prairie Aquic Hapludolls Somewhat poorly drained Hydric: No Ap A1 A2 AB Btq1 Btg2 -81 Btg3 -107BCa1 -122 BCq2 163 interfluves / Shoulder

interfluves / Summit

### **Soil series**

Hydric: No

Ap

A2

Bw1

Bw2

### 175C: Dickinson fine sandy loam, 5 to 9 percent slopes (408569) Dickinson (90%) Sparta (5%)

Sandy Upland Prairie Sandy Upland Prairie Typic Hapludolls Entic Hapludolls Well drained Excessively drained Hydric: No Ap AB Bw1 -91 Bw2 -152 dunes / Summit dunes / Shoulder dunes / Backslope 183 Bt 203

Dickinson (5%) Sandy Upland Prairie Typic Dystrudepts Well drained Hydric: No Ap -23 A1 A2 Bw1 -61 Bw2 -76 -91

-152 dunes / Summit dunes / Shoulder

dunes / Backslope





### <u>Staff</u>



Jean Bertrand Contina Research Director



Linda Sturm-Flores Research Technician



**Drew Erickson** Farm Manager



Brooke Roberts Research Intern

### **Organic Consultants**

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Léa Vereecke Midwest Regional Manager



Nicholas Podoll Great Plains Regional Manager

### **Expertise:**

- Cover cropping
- Reduced tillage systems
- Organic row crops
- Small grains
- Industrial hemp

### **Expertise:**

- Organic farmer
- Vegetable production
- Organic row crops
- Small grains
- Rangeland



### Certified organic farms: Top 10 states (USDA-NASS 2019 survey)

State	Land (acres)	Operations (number)	Total sales (million USD)	Average sales/farm (thousand USD)
California	965,257	3,012	3,596.90	1,198
Wisconsin	250,940	1,364	268.90	198
New York	323,081	1,321	298.40	227
Pennsylvania	107,550	1,048	741.80	714
Ohio	111,920	785	117.00	150
lowa	133,691	779	144.60	186
Washington	111,930	745	886.00	1,192
Vermont	203,002	655	159.70	245
Minnesota	172,968	635	113.60	179
Indiana	-	595	181.0	305
United States	5,495,274	16,585	9,925.90	601



# **Research priorities**

Organic dry bean production	<ul> <li>Optimizing the benefits of cover crops and no-till system.</li> </ul>					
Organic vegetable production	<ul> <li>Improving soil health using no-till practices.</li> </ul>					
Alternative cropping systems	<ul> <li>Diversifying corn-soybean rotation with livestock integration.</li> </ul>					
Organic corn production	<ul> <li>Optimizing animal manure application and soil fertility.</li> </ul>					
Agroforestry system	<ul> <li>Integrating trees, pasture, small grains, and livestock.</li> </ul>					

# <text>



### **Objectives:**

- Evaluate suitability and profitability of various small grains, pulse crops, and oilseeds as alternative crops for the Midwest.
- Determine agronomic, economic, and environmental benefits of diversified cropping systems with livestock integration.
- Disseminate project results to farmers throughout the Midwest region.
- Increase expansion of organic farming throughout the Midwest by providing technical support to the farmers.





# The share of global harvested cropland area that goes to direct food



World Resources Institute, 2022





Source: USDA







			Field B - Crop Diversity Study - Fall 2022 Planting																						
				Blo	ck 1		В	lock 2	2											Blo	ock 3				
Canola	Wheat	Barley	Реа	Rye	<b>Fallow</b> (Sunflower, Soybean, Grain sorghum, cowpeas)		<b>Fallow</b> (Sunflower, Soybean, Grain sorghum, cowpeas)	Реа	Wheat	Rye	Canola	Barley		(Sun G	Fal Iflower rain s cow	<b>low</b> r, Soyb orghur peas)	ean, n,	Canola	Wheat	Реа	Rye	Barley	Fa (Sunflow Grain cov	<b>allow</b> ver, Soybean sorghum, wpeas)	,
			Nort	h																					



### Yield assessment

Soil type	Сгор	System	Yield (lbs./acre)	Conventional yield (lbs./acre)	Standard deviation	Standard mean error
Fine sandy loam	Cowpea	No-till	411.01	900 — 1,350	207.86	84.86
Fine sandy loam	Grain Sorghum	Till	908.84	4,480 – 6,720	578.89	236.33
Fine sandy loam	Soybean	No-till	2,088.27	3,840 – 4,000	406.61	166.00
Fine sandy loam	Sunflower	Till	847.98	1,500 – 3,000	194.04	79.21
Silty clay loam	Cowpea	No-till	412.12	900 – 1,350	316.83	182.92
Silty clay loam	Grain Sorghum	Till	596.69	4,480 – 6,720	168.86	97.49
Silty clay loam	Soybean	No-till	1,700.17	3,840 – 4,000	932.36	538.30
Silty clay loam	Sunflower	Till	876.80	1,500 – 3,000	348.44	201.17

### **Objectives:**

- Restore degraded land and protect against erosion.
- Diversify the monoculture-based cropping systems by integrating trees into annual crop and livestock agroecosystems.
- Diversify income sources for farmers and landowners to provide a safety net against market volatility and climate change.
- Mitigate climate change by increasing carbon sequestration potential in soil and above ground biomass.
- Increase knowledge and collaboration between agroecological research institutions.





(pawpaws, berries) grown between rows of trees.

### **Experimental design**



# Enhancing Agroecosystem Services through Agroforestry

### **Spatial analysis: Soil physical characteristics**



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Dielectric permittivity

### Temperature





### Electrical conductivity





# **Objectives:**

- Determine the biomass production of two varieties of rye planted at three different seeding rates.
- Determine dry bean yield when planted at three different seeding rates.
- Evaluate the efficacy of roller-crimped rye in controlling the prevalence of weeds in the field.
- Evaluate soil nutrients availability in till and no-till systems.





### **Cover crop benefits**

- Increases soil organic matter
- Reduces soil erosion
- Controls weeds
- Reduces soil compaction
- Provides a nitrogen source
- Provides nitrogen scavenging
- Increases infiltration
- Increases cash crop yields



Jeff Moyer, CEO Rodale Institute.



### Effect of agricultural disturbances on soil organic carbon





### Four key soil health indicators show evidence of improvement with cover crop use over 3-5 years.

Wood, S.A., and M. Bowman 2021.







Aggregate Stability



Soil organic matter



Cover crop effect on soil



### Soil physical factors: Cereal rye

### Soil moisture





2,000,000

1,500,000

,000,000

500,000

0

Tillering (tillers/acre)

# **Dry Beans Production in Roller-crimped Rye**

### **Cereal rye growth and development**

Rye tillering count



**Rye biomass** 



### **Rolling down cereal rye**









Seeding rate (seed/acre)







### Soil water content: Dry beans

Date





### Soil temperature: Dry beans

Date





### **Electrical conductivity: Dry beans**

Date



### Soil analysis: Dry beans

### **Organic matter**



### Phosphorus





### **Total Nitrogen**







### **Yield assessment: Dry beans**



### Dry beans yield



### 2023 Dry beans trials: Seeding densities in till & no-till lands



Cereal rye (ND Gardner) - January 6, 2023



Cereal rye (ND Gardner) - January 16, 2023



# **Education | Consulting | Outreach**

### 2022 MOC Field Day







# **Education | Consulting | Outreach**



### Survey & questionnaire





# **Education | Consulting | Outreach**

### **Conferences and farmer's field days**



- 2022 in summary: 18 conferences | 7 webinars | 1 Field Day | 3 Newsletters | 3 News Media Interviews | > 15 field tours | and > 1,300 participants across the Midwest.
- As of November 7, 2022, 46 Midwest farmers have committed to transitioning a total of 10,542 acres of land to organic production with direct support from MOC consultants.



### **Conferences & Events for 2023**

Event	Location	Role	Date
Rodale Institute - Research	Online	Presentation	January 18
Practical Farmers of Iowa	Ames, IA	Presentation & booth	January 19-21
Rodale Institute - Education	Online	Presentation	February 1
Marbleseed Conference	La Crosse, WI	Posters & booth	February 23-25
Iowa Specialty Producers	Ankeny, IA	Presentation	February 22-23
PFI Midwest Covers & Grains	Cedar Rapids, IA	Booth	March 1-2
Steering Committee Meeting	Online	Presentation	March
DSSAT Training Workshop	Griffin, GA	Training	May 15-20
APS North Central Division	-	Poster presentation	June
MOC Field Day	Marion, IA	Field Day	August 16
ASA, CSSA, SSSA Conference	St. Louis, MO	Poster presentation	Oct. 29-Nov. 1
Iowa Organic Conference	Iowa City, IA	Presentation & booth	November



# **Future directions**

- Alternative cropping system
- No-till vegetable production
- Optimizing cover crop management
- Agroforestry project
- Small grain variety trials
- Expand education and outreach
- Expand research collaboration with universities and private institutes





# MOC thanks its sponsors, supporters, and collaborators:

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IOWA DEPARTMENT OF AGRICULTURE & LAND STEWARDSHIP



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### Rodale Institute Midwest Organic Center - Rodale Institute





# Healthy Soil = Healthy Food = Healthy People

# Thank you! Questions

