

BACKGROUND

- Drought and extreme heat cause a **10% decrease** in global cereal production, 5-7% reduction in yield annually (Lesk et al., 2016).
- System-wide models predicting effects of climate change on agriculture have emphasized the need for research into processes that enhance tolerance to drought and heat (Wiebe et al., 2015).
- Hypothesis: Organic farming can lead to improved soil health and increase in organic matter which will improve hydraulic properties.
- **Objective:** Compare and contrast hydraulic conductivity, water retention, organic carbon and nitrogen among six different farm management systems at Rodale Institute's Farming Systems Trial.
- **Goal:** Determine the optimal practices that lead to drought resistance, flood mitigation and improved water retention properties.

FARMING SYSTEMS TRIAL



MNR	LEG	5	CONV	CONV	Synthetic Conventional		
+ No-Till 2008			2008	B k B	Berks-Weikert channery		
Agricul	tural T	Freat	tments		to 8 percent slopes [42,42		
MNR-T	LEG	- <i>T</i>	CONV-T	CmB	Clarksburg silt loam, 3 to		
MNR-NT	LEG-I	NT	CONV-NT		Clarkshurg silt logra 0 to		
Sample D	ate	Ju	ly 2018	CmA	percent slopes [27,54,19]		

MATERIALS AND METHODS

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		Compo	osite Soil Sa	amples	Intact HYPROP Cor			
	Depth (cm)	0 - 10	10 – 20	20 - 30	0 - 10	10 – 20	2	
	Field Procedure	At each depth/plot, composite sample collected from 10 locations (n=24)			At each depth/plot, inta core collected from one (n=24)			
	Instrument	Costech ECS 4010			METER H	YPOP ¹ /WP	4C ¹	
	Soil	Total Ca	arbon & Ni	¹ Water Retention Curve Air-Filled Pores (AF				
Properties	*samples did not contain carbonates			² Saturated Hydrau Conductivity (K _S)				

Assessing the Impact of Organic Farming Practices on Building Drought Resistant Soil Abdel Alfahham¹, Alain Plante¹, Daniel Gimenez², Emmanuel Omondi³ University of Pennsylvania, Rutgers University, Rodale Institute





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/KSAT² (WRC) P)

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DATA ANALYSIS

• Two-way Analysis of Variance (ANOVA) on carbon & nitrogen, K_s, AFP were conducted using IBM SPSS 25

WRC & AFP

1. Peters-Durner-Iden (PDI) model (Peters & Durner, 2015) fitted to HYPROP and WP4C data using SoilHyP/fitSHP R package (*Dettmann et al., 2018*).

 $S_e = \sum_{i=1}^{\kappa} W_i \left[\frac{1}{1 + (\alpha_i |\Psi|)^{n_i}} \right]^{m_i}$

2. PDI parameters were used to calculate volumetric water content (θ_i) at different pressure potentials (Ψ, cm) :

$$\theta_i = S_e(\theta_S - \theta_r) + \theta_r$$

 $\Psi = 10, 30, 50, 100, 300, 1000, 15000 \ cm$

3. Air-Filled Pores (AFP), portion of the total soil porosity containing air, was calculated at the same potentials using: $AFP = \theta_s - \theta_i$

RESULTS AFP

Air-Filled Pores 0 – 10 cm	p-value								
Ψст	10	30	50	100	300	1,000	15,000		
Soil Type (USDA)	.001	.021	.039	.052	.048	.046	.094		
Treatment	.106	.244	.272	.359	.370	.328	.262		
Tillage	.030	.355	.599	.566	.566	.588	.604		
Soil Type x Treatment	.861	.997	.982	.980	.970	.996	.832		
Soil Type x Tillage	.006	.107	.138	.202	.182	.164	.123		
Treatment x Tillage	.303	.399	.335	.381	.361	.435	.487		
Soil Type x Treatment x Tillage	.259	.543	.523	.652	.651	.685	.914		



also observed between the tillage systems at 0 – 10 cm and 20 – 30 cm.

Multimodal Retention Function (Durner, 1994)



FUTURE ANALYSES

In order to investigate the relationship between soil organic carbon & nitrogen and soil hydraulic properties, more data about the soil cores have to be collected. 72 Intact HYPROP cores will be analyzed for:

- 1. Soil Texture (Grain Size Distribution)
- 2. Total Carbon & Nitrogen
- 3. Organic Carbon & Nitrogen
- 4. Rock Weight and Volume

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5. More soil water retention curves will be collected.

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Total Carbon: Statistically significant differences between organic and conventional treatments. Differences between till and no-till were not significant.

Total Nitrogen:

Statistically significant differences between organic and conventional treatments. Similar to carbon, difference between till and no-till were not significant.

Carbon-to-Nitrogen Ratio : Statistically significant interaction between treatment x tillage at 10 – 20 cm and 20 – 30 cm depths. Treatment or tillage individually were not significantly different.