

The Farming Systems Trial: 40 Years of Research Comparing Conventional and Organic Systems

Dr. Philip Osei Hinson



RODALE
INSTITUTE™



J.I. Rodale
1898-1971

- Founded the Rodale Press and Rodale Institute (1947).

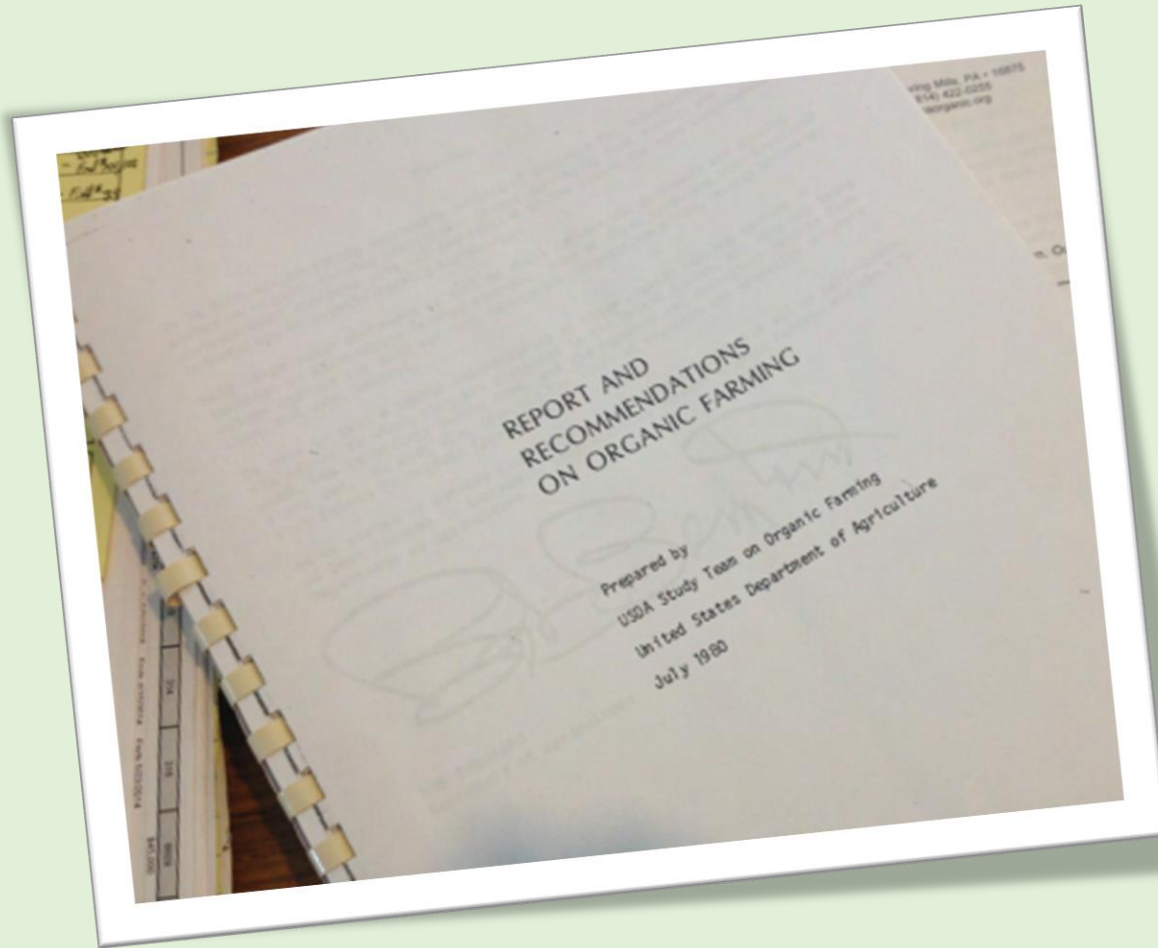


Started in 1981, the longest running side-by-side comparison of **organic** and **conventional** farming systems in North America

FARMING SYSTEMS
TRIAL



Why was the FST Initiated?



Key Points of the Report

- ☐ Organic farming comprises a wide spectrum of farmers, farming methods, and farm size
- ☐ Most organic farmers utilize crop rotations, cover crops, and manures where available
- ☐ Organic farms tended to be more labor intensive, but less energy intensive than conventional farms
- ☐ **Many farmers reported significant yield reductions for the first 3 to 4 yr following a switch to organic methods.**

- ☐ To study the transition from conventional farming to organic farming and define yield-limiting factors that occur during the transition process.



Conventional



Organic Legume



Organic Manure

Cash crops:

Cover Crops:

Inputs:

Corn – Corn - Soy

None

Synthetic

Corn – Oats – Soy - Wheat

Rye, Clover, Hairy Vetch

none

Corn-Oats-Soy-wheat-3 years
Hay-Corn silage-Wheat

Rye, Clover, Hairy Vetch

Composted Manure

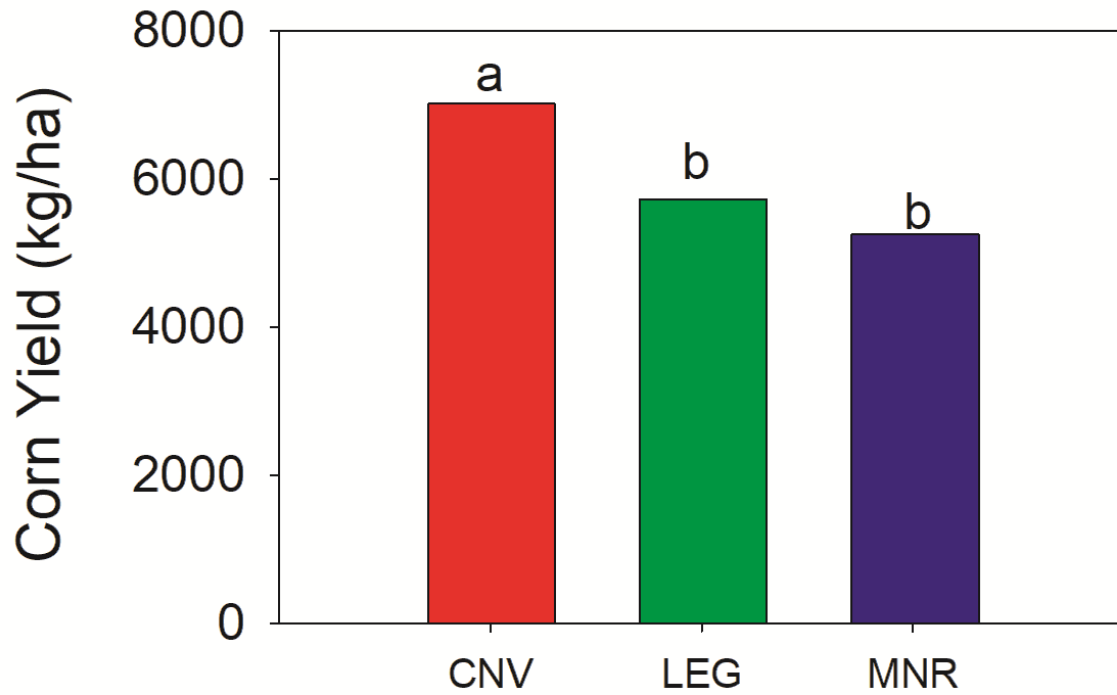
Areas of Research

- Yields
- Soil health
- Environmental quality
- Economics

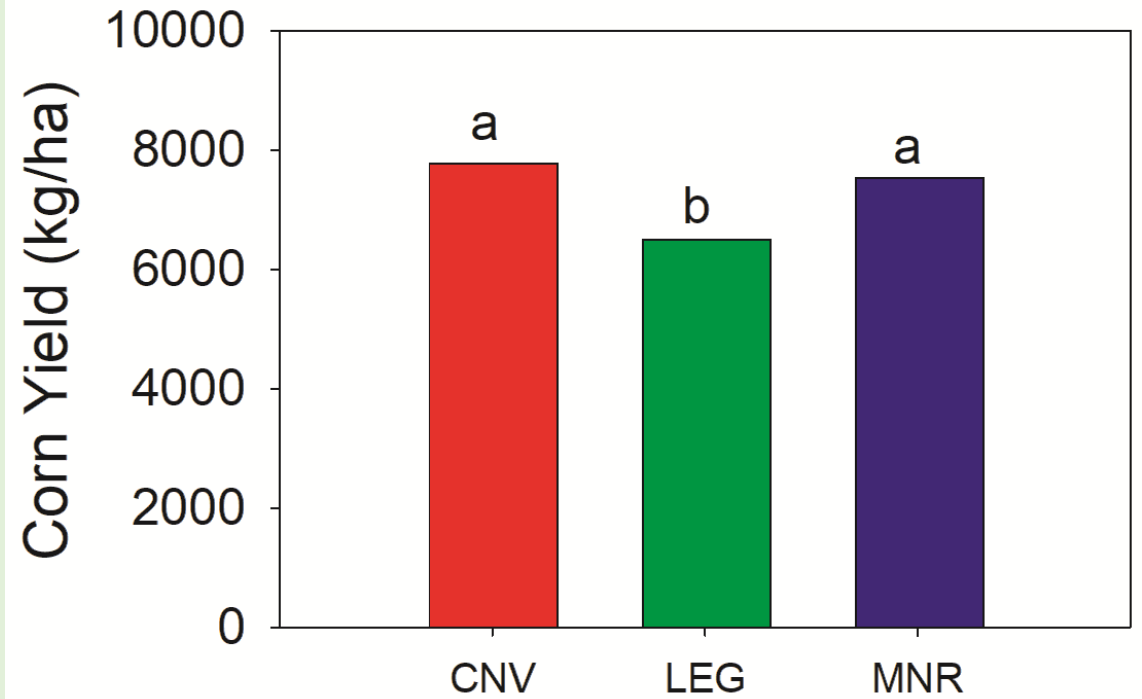


Corn Yield (kg/ha)

Corn Yield (1981-1985)

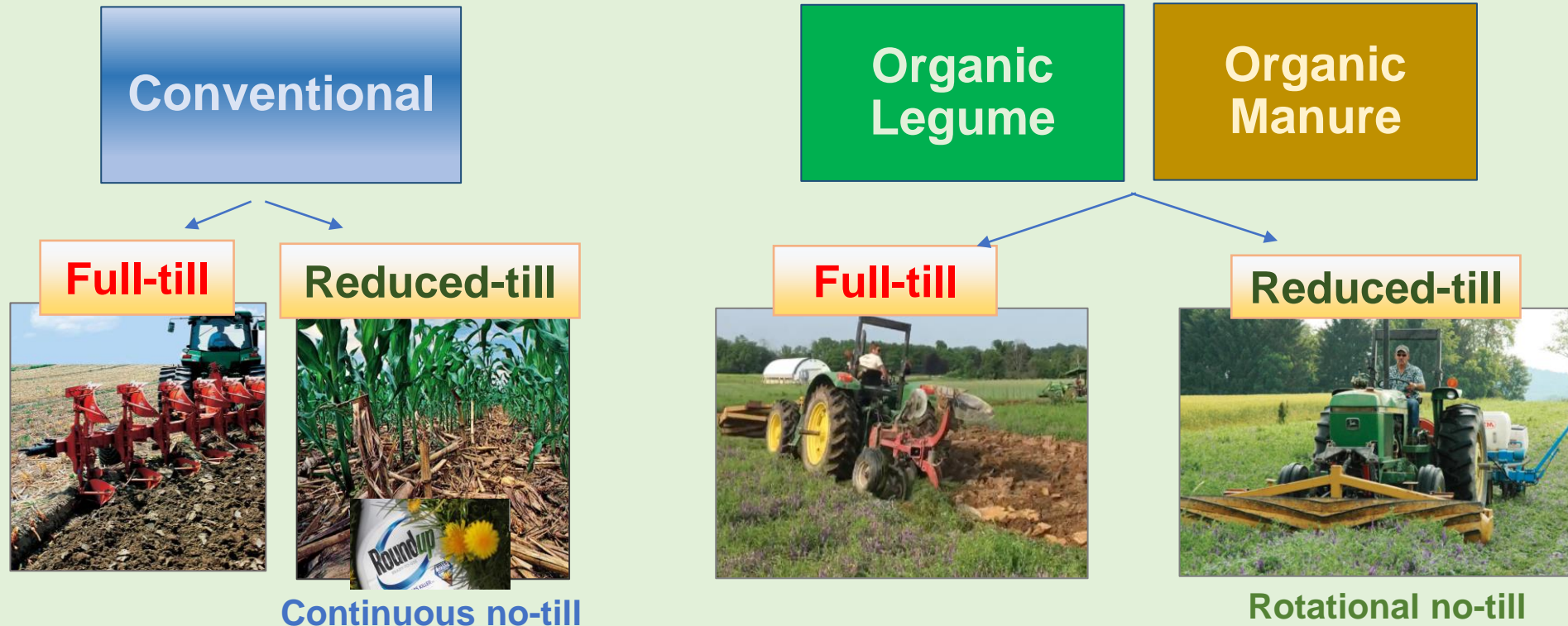


Corn Yield (1986-2007)



Tillage Treatment

- ❑ In 2008, all three systems were divided into “Full-till” and “Reduced-till”.
- ❑ Reduced tillage is achieved in *different* ways in conventional and organic systems.



The Organic No-till System

1

Plant annual cover crops
in the fall



2

Terminate the cover crops mechanically
in the spring and plant cash crops into
the residues



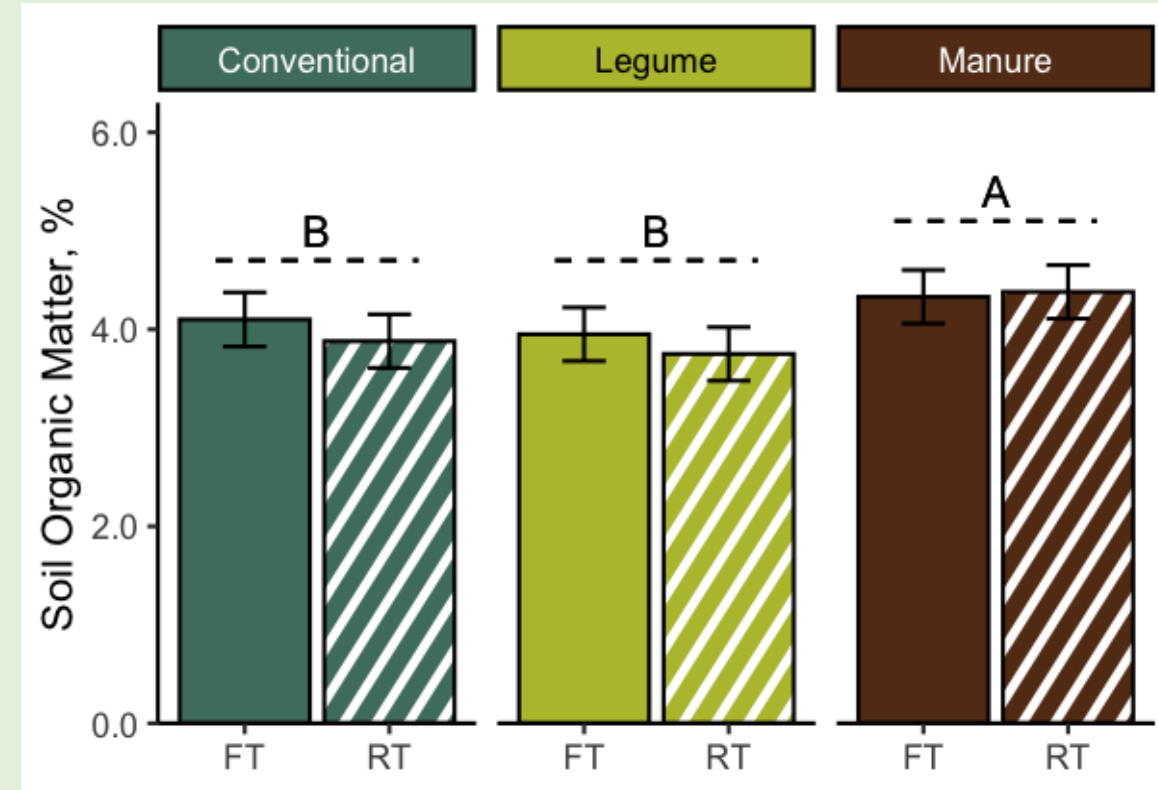
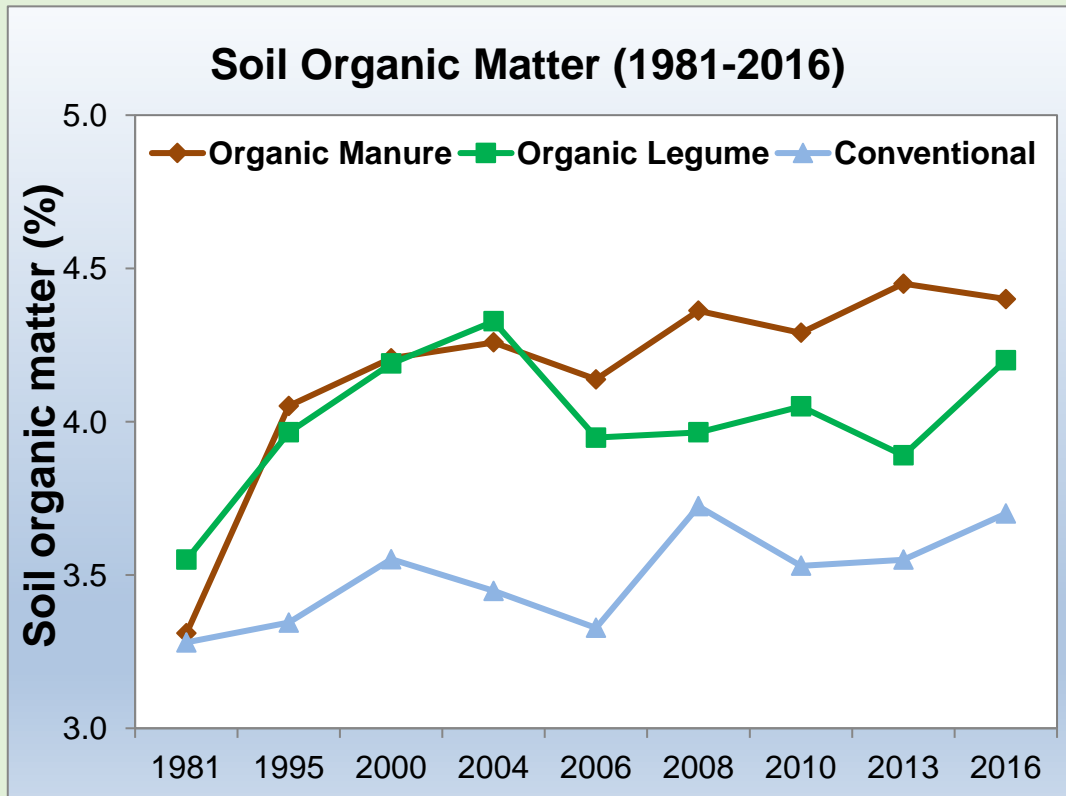
3

Cover crop residues become a weed-
suppressing mulch



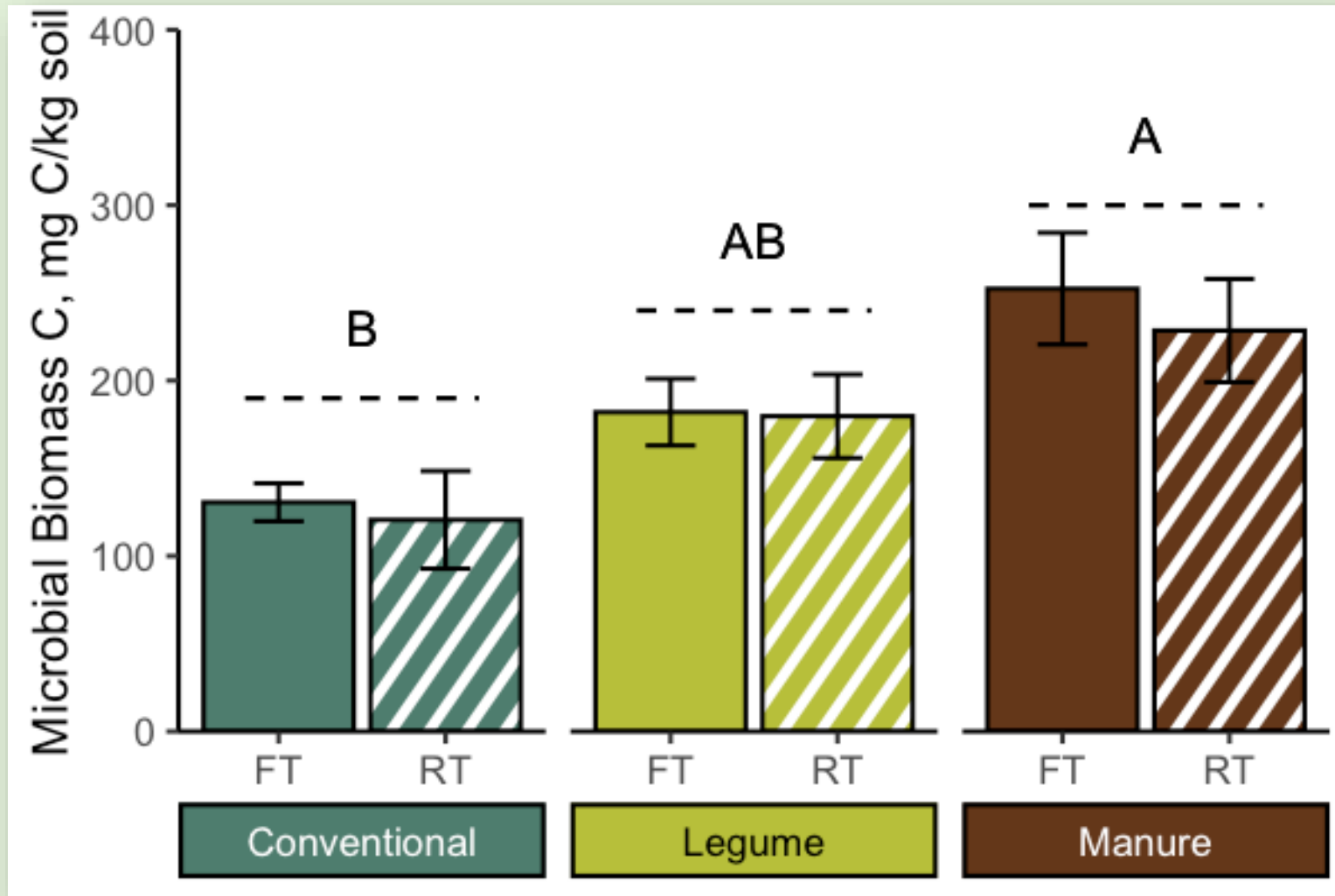
Soil Organic Matter (0-20 cm)

2020



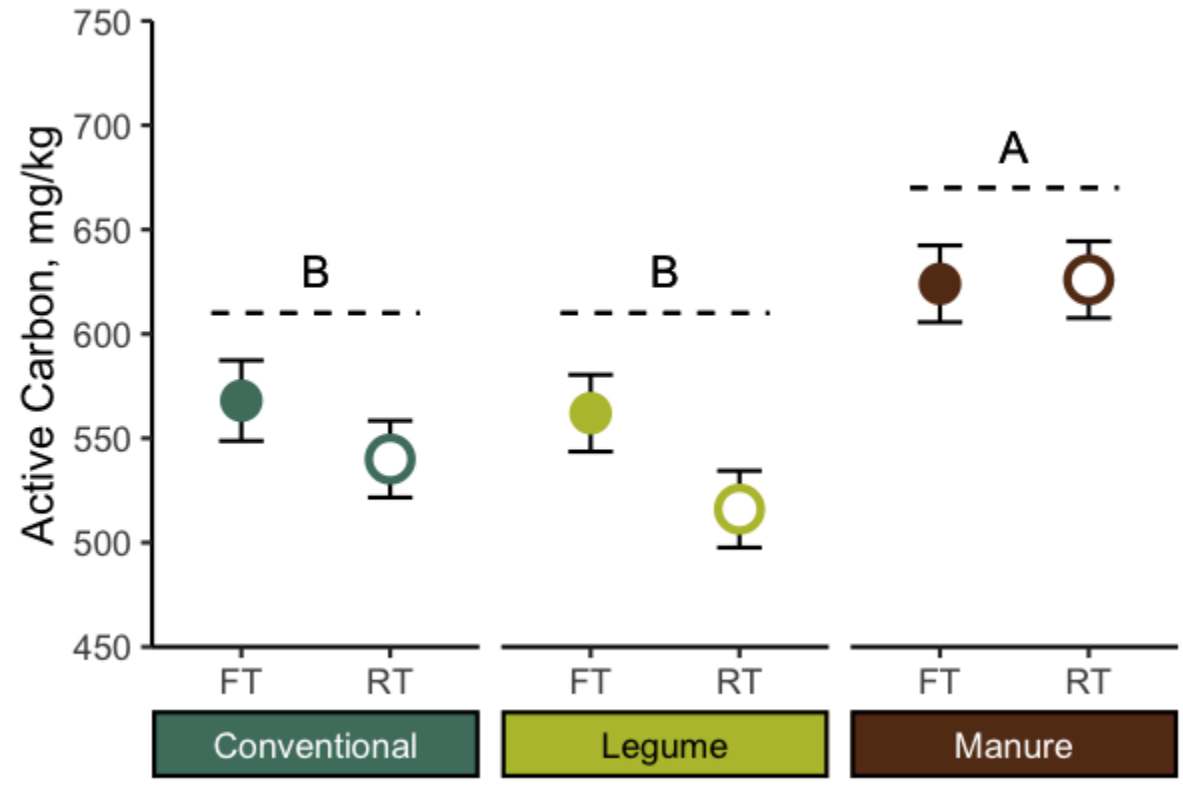
Microbial Biomass C (0-30 cm)

2019 and 2020

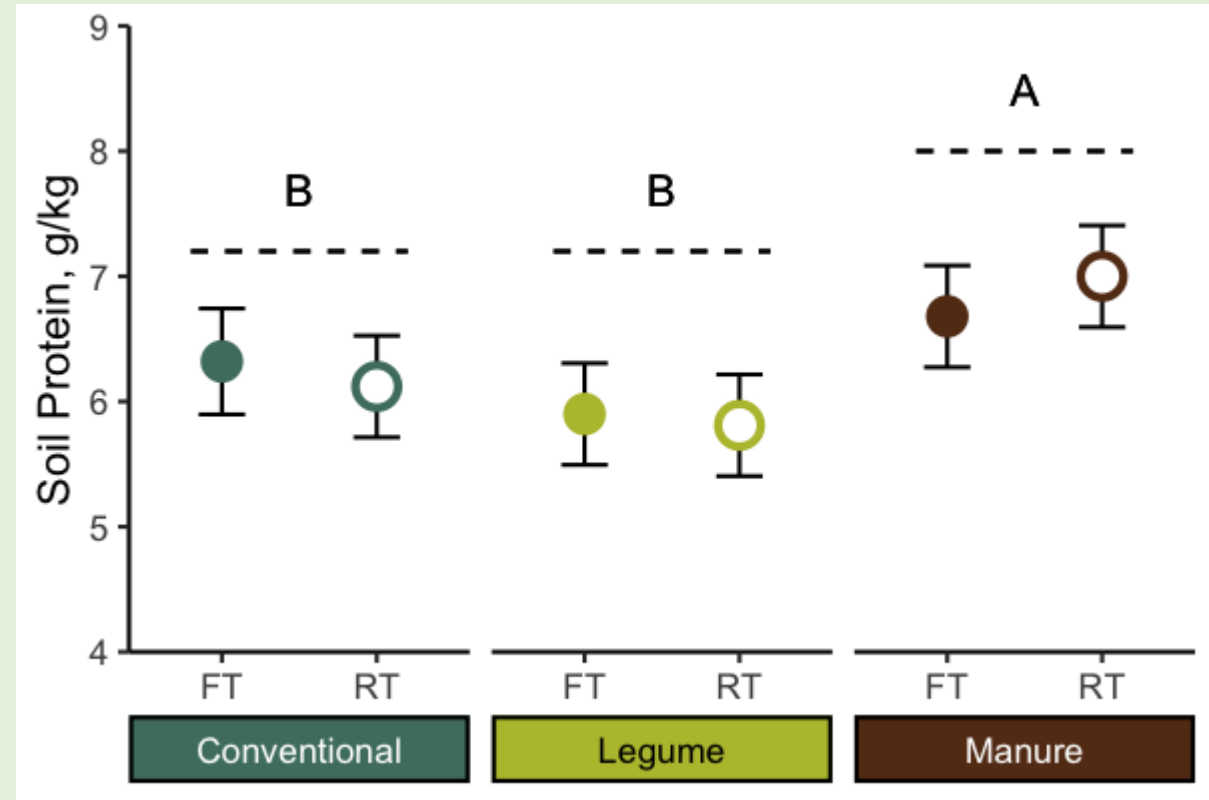


Soil Labile Organic C and N

2019 and 2020



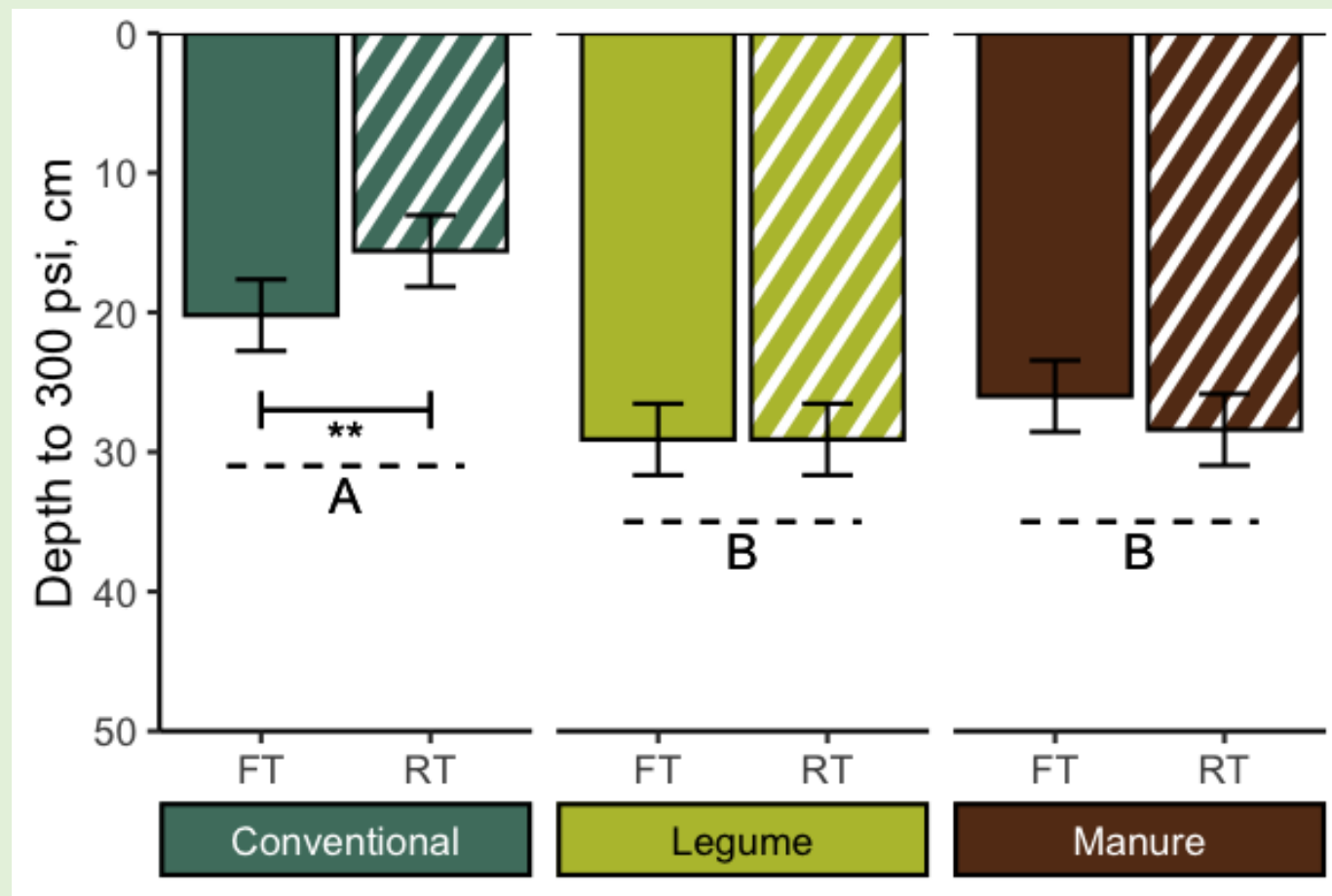
Active C, measured as permanganate oxidizable C, is significantly higher in the organic manure system than the conventional and organic legume systems.



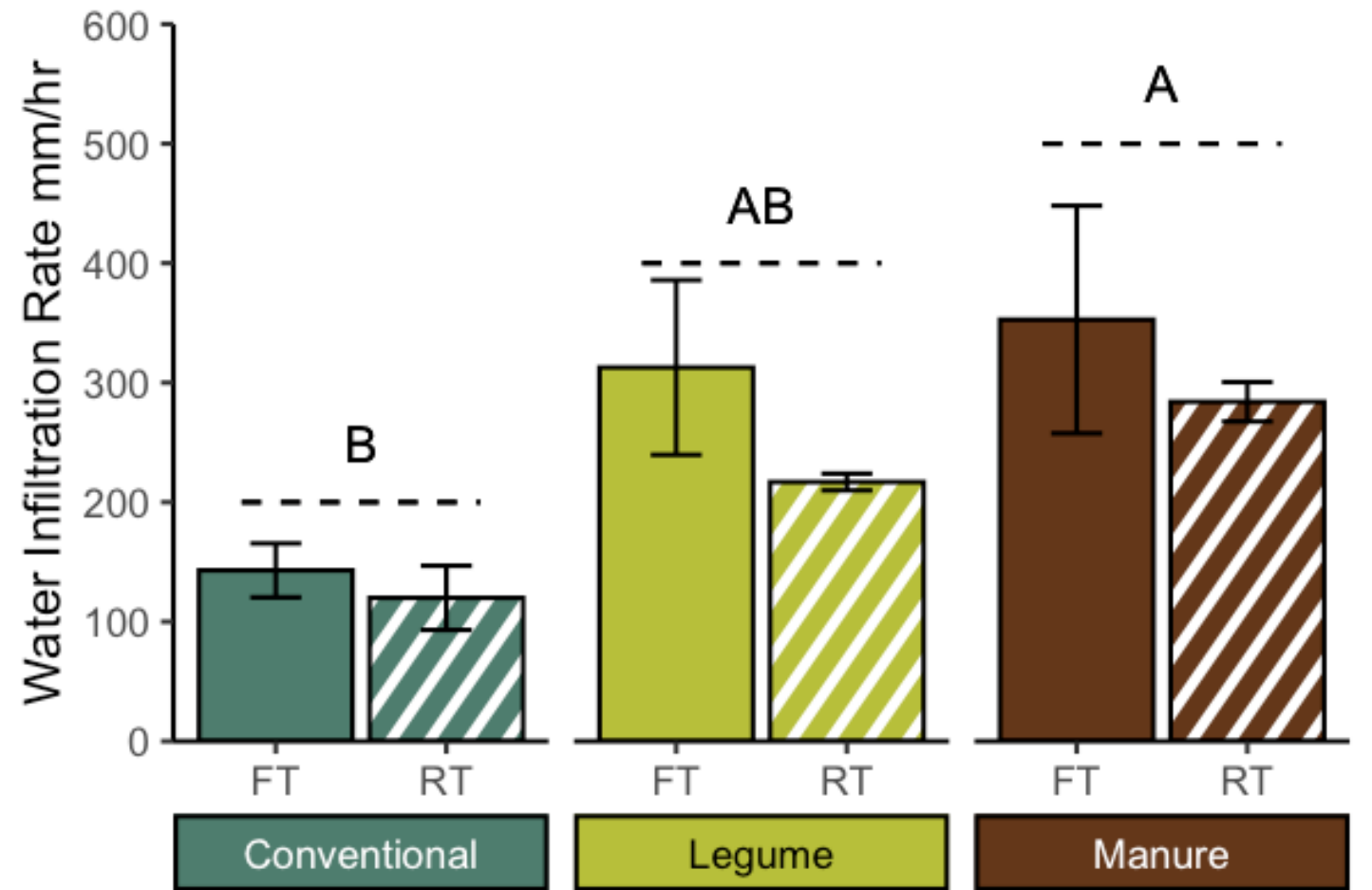
Soil protein levels, measured as autoclaved citrate extractable (ACE) protein, are significantly higher in the organic manure system than the conventional and organic legume systems.

Soil Compaction (0-20 cm)

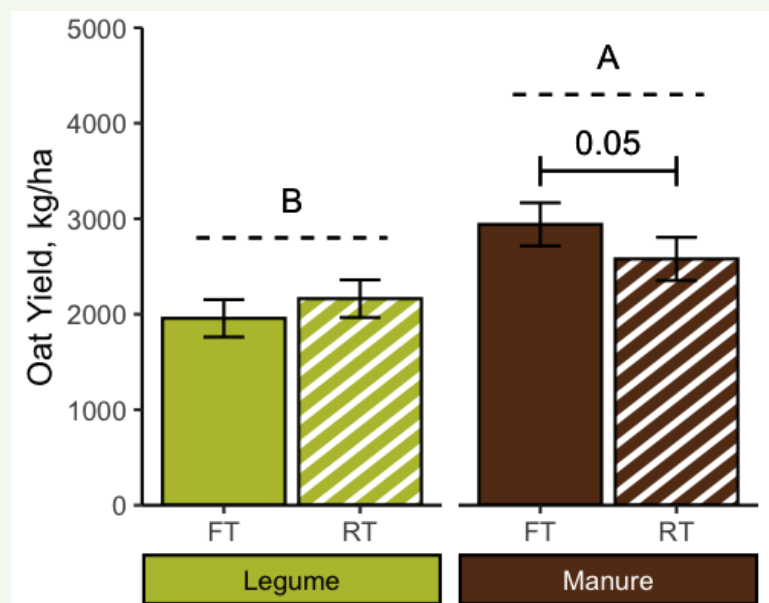
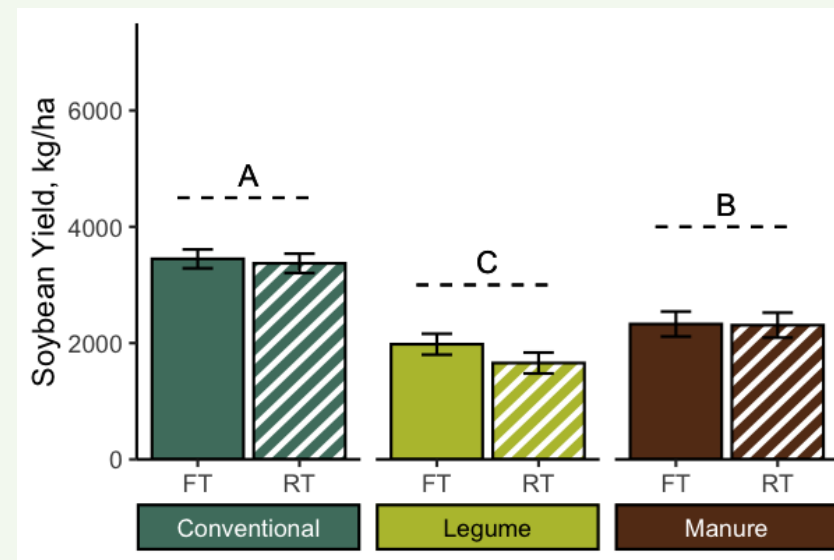
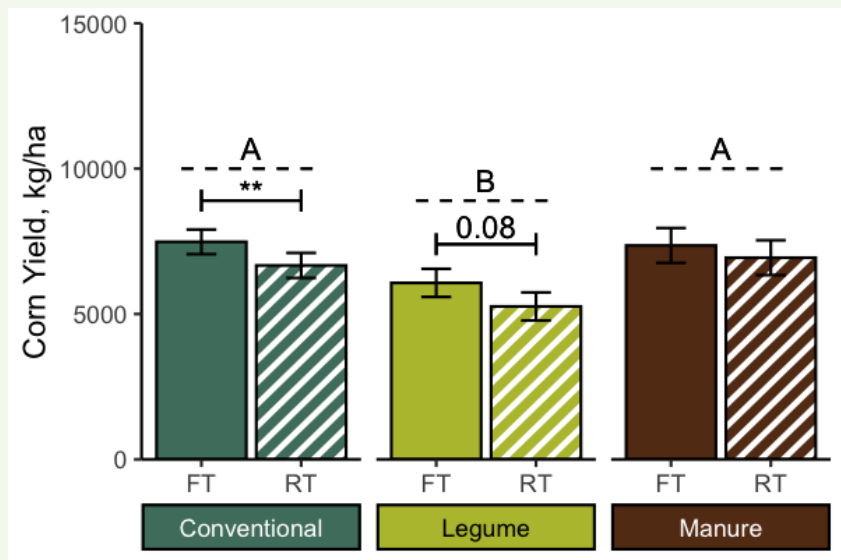
2019 and 2020



Water Infiltration



Crop yields (2008-2020)



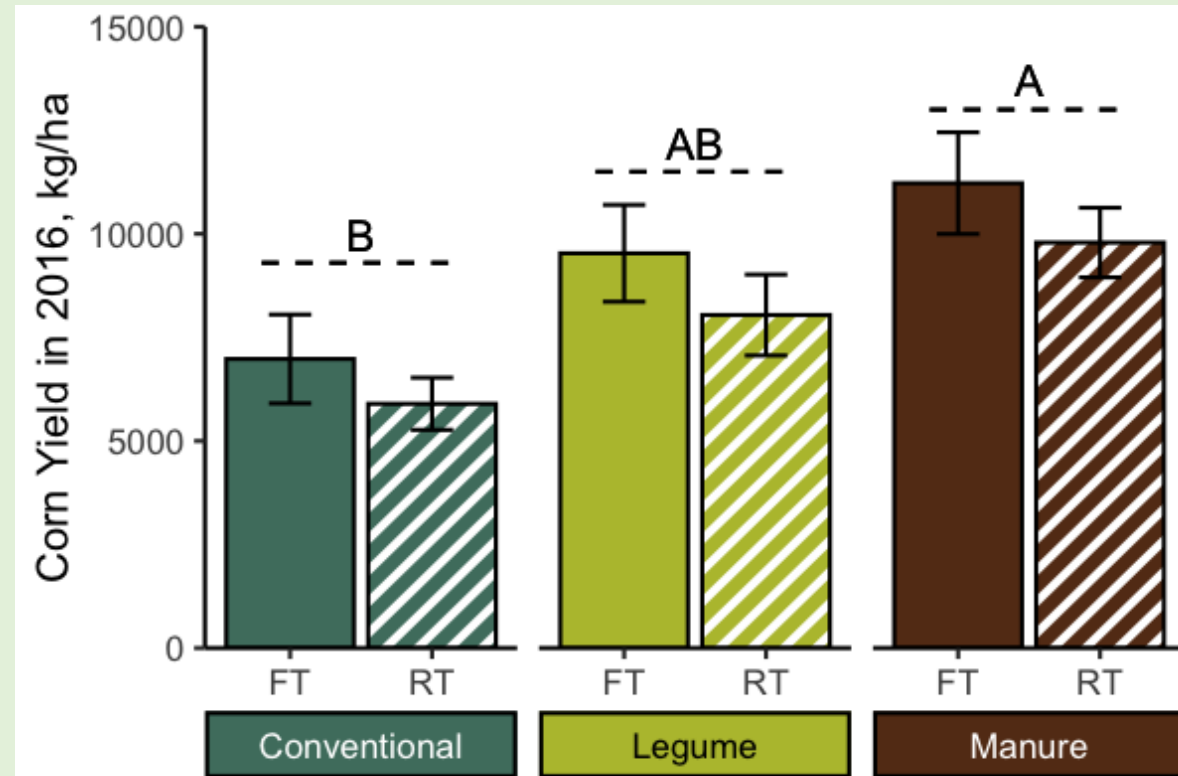
Drought Conditions

The performance of organic and conventional cropping systems in an extreme climate year

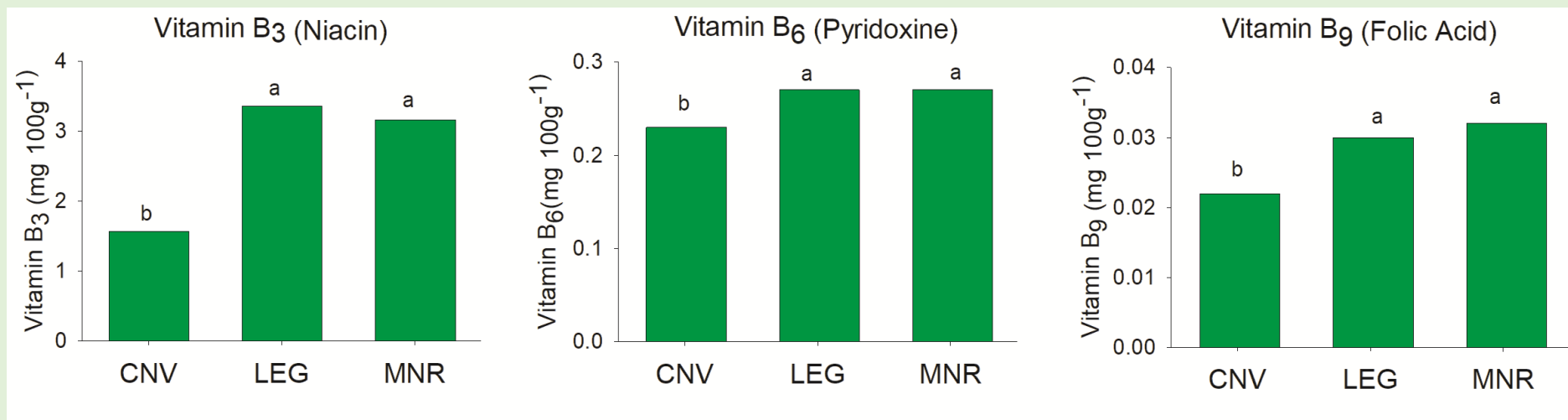
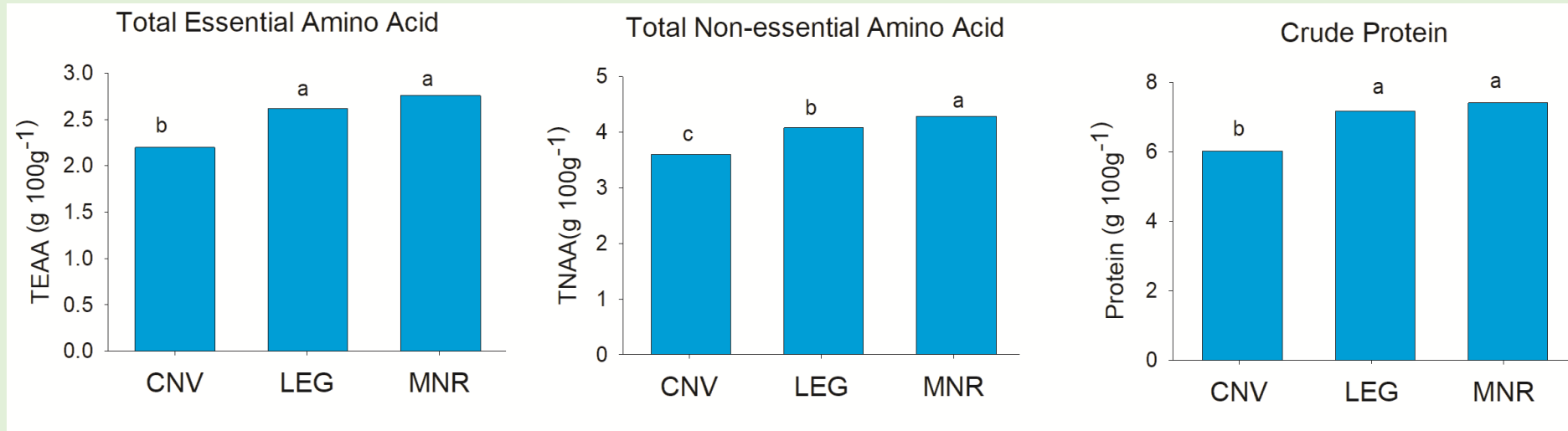
D.W. Lotter, R. Seidel, and W. Liebhardt

Abstract. The 1999 severe crop season drought in the northeastern US was followed by hurricane-driven torrential rains in September, offering a unique opportunity to observe how managed and natural systems respond to climate-related stress. The Rodale Institute Farming Systems Trial has been operating since 1981 and consists of three replicated cropping systems, one organic manure based (MNR), one organic legume based (LEG) and a conventional system (CNV). The MNR system consists of a 5-yr maize-soybean-wheat-clover/hay rotation, the LEG of a 3-year maize-soybean-wheat-green manure, and the CNV of a 5-yr maize-soybean rotation. Subsoil lysimeters allowed quantification of percolated water in each system. Average maize and soybean yields were similar in all three systems over the post-transition years (1985–1998). Five drought years occurred between 1984 and 1998 and in four of them the organic maize outyielded the CNV by significant margins. In 1999 all crop systems suffered severe yield depressions; however, there were substantial yield differences between systems. Organic maize yielded 38% and 137% relative to CNV in the LEG and MNR treatments, respectively, and 196% and 152% relative to CNV in the soybean plots. The primary mechanism of the higher yield of the MNR and LEG is proposed to be the higher water-holding capacity of the soils in those treatments, while the lower yield of the LEG maize was due to weed competition in that particular year and treatment. Soils in the organic plots captured more water and retained more of it in the crop root zone than in the CNV treatment. Water capture in the organic plots was approximately 100% higher than in CNV plots during September's torrential rains.

Crop yield in 2016, an extremely dry year (9 inches of rainfall, June 1 – Aug 31)



Corn Nutrient Composition



Major Issue with Conventional NO-Till



Herbicides-resistant weeds



Highlights

- ❑ Positive evidence for the long-term (> 40 years) viability of organic cropping systems.
- ❑ During the first few years of transitioning from conventional to organic, crops that requires small amount of N should be used. e.g., small grains.
- ❑ Corn nutrient composition was affected by systems, but not tillage.
- ❑ Under extreme climatic conditions (drought), organic systems were more resilient than the conventional system.
- ❑ Efforts are needed to continue to reduce tillage in organic systems.

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