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## Experiment

Research was conducted at Iowa State University's Marsden Farm, Boone, IA, to determine fossil energy use in three cropping systems:

- 2-year rotation: Corn and soybean
- 3-year rotation: Corn, soybean, and small grains (triticale or oat) + red clover
- 4-year rotation: Corn, soybean, small grains, and alfalfa hay

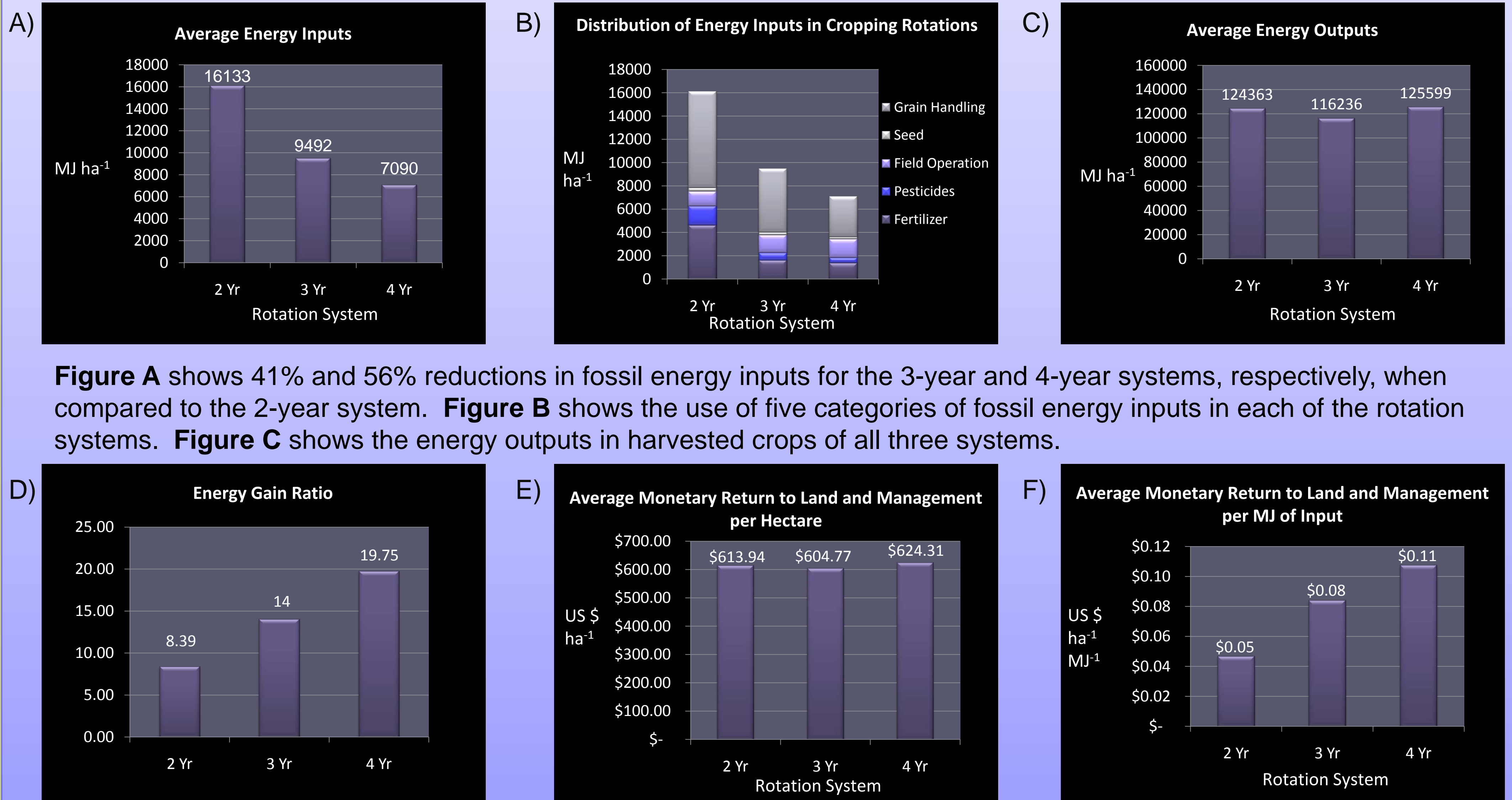
The 2-year rotation was managed conventionally, whereas the 3-year and 4-year systems received reduced rates of synthetic N fertilizer and herbicides. Field work began in 2002. Plot size was 60' x 275'.

Picture 1. Aerial picture of the crop rotation experiment, Boone, IA.

## Key Assumptions

- We focused on purchased inputs of energy because these are within the control of the farm manager.
- Manure was applied to the 3-year and 4-year rotation systems. It was considered to be a waste product and only the application operation was considered as part of the energy costs.
- Hauling distances were limited to ½ mile one way. Beyond removing the crop from the field, the distance traveled is largely dependent on marketing choices, which were outside the focus of this project.
- Grain drying was included in the analysis, but storage of grain was not, as it is a part of marketing the grain, not producing it.
- All field operations were idealized to match normal farm scenarios (e.g., alfalfa was always considered to be cut, raked, and baled even though the alfalfa was chopped directly in several cases).
- More information concerning the field experiment can be found in Liebman et al. (2008), *Agronomy Journal* 100: 600-612.

## Data: 2003 - 2008



**Figure D** shows energy output in harvested crops per unit of fossil energy input. **Figure E** shows monetary returns per unit land area for the three rotation systems. **Figure F** shows monetary returns per unit of fossil energy invested, with the 3-year and 4-year systems greater than the 2-year system by factors of 1.8 and 2.3, respectively.