# Performance of Organic Farming Systems and Implications on Climate Change

**Erin Silva, University of Wisconsin**

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http://www.extension.org/organic_production


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# Performance of Organic Farming Systems and Implications on Climate Change

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# The Wisconsin Integrated Cropping Systems Trial

# Wisconsin's organics tops the national ranks

- #1 for total organic livestock
- # 1 for field crop acreage
- #1 for total organic milk cows (22% of USA total)
- #2 in organic milk sales (64% of organic sales)
- #2 in organic farms (n=1159 farms)
- # 10 in vegetables
- **Organic dairy and livestock farms drive market for organic feed**

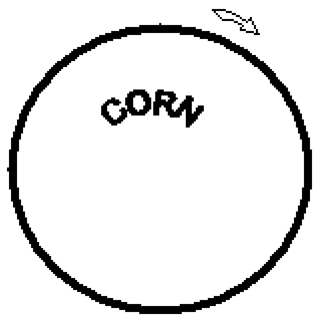
Source: UW-Madison CIAS/DATCP 2012 status report

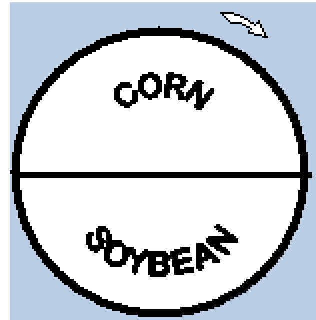
# WICST was born in 1989

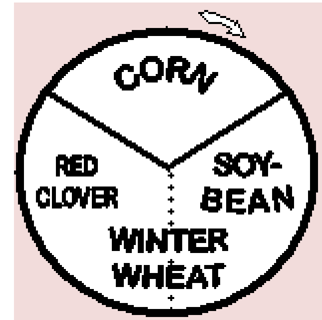

- Two locations:
  - Arlington (well drained silt loam soils)
  - Lakeland (more-poorly drained silt loam soils)
- Over 20 years of data summarized:
  - from 1992 to 2012
  - Trends emerging
    - Economics
    - Soil carbon
    - Yield trends
    - Weed seed

WICST:
Lakeland site

# Cash-grain systems



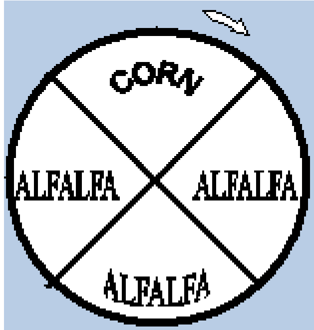



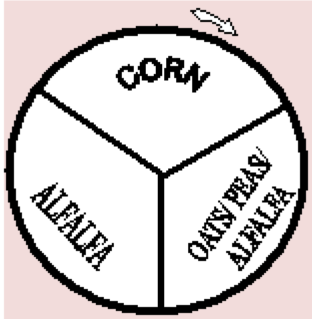

Continuous corn

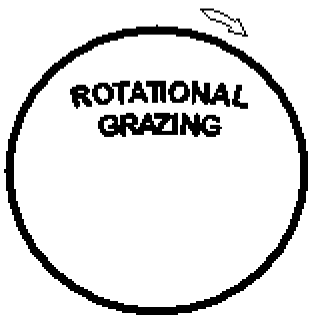
Strip-till corn-soybean

Organic grain

Dairy (forage-based) systems




Conventional Alfalfa

Organic forage

Managed grazing

# Effect of weed pressure on corn yield

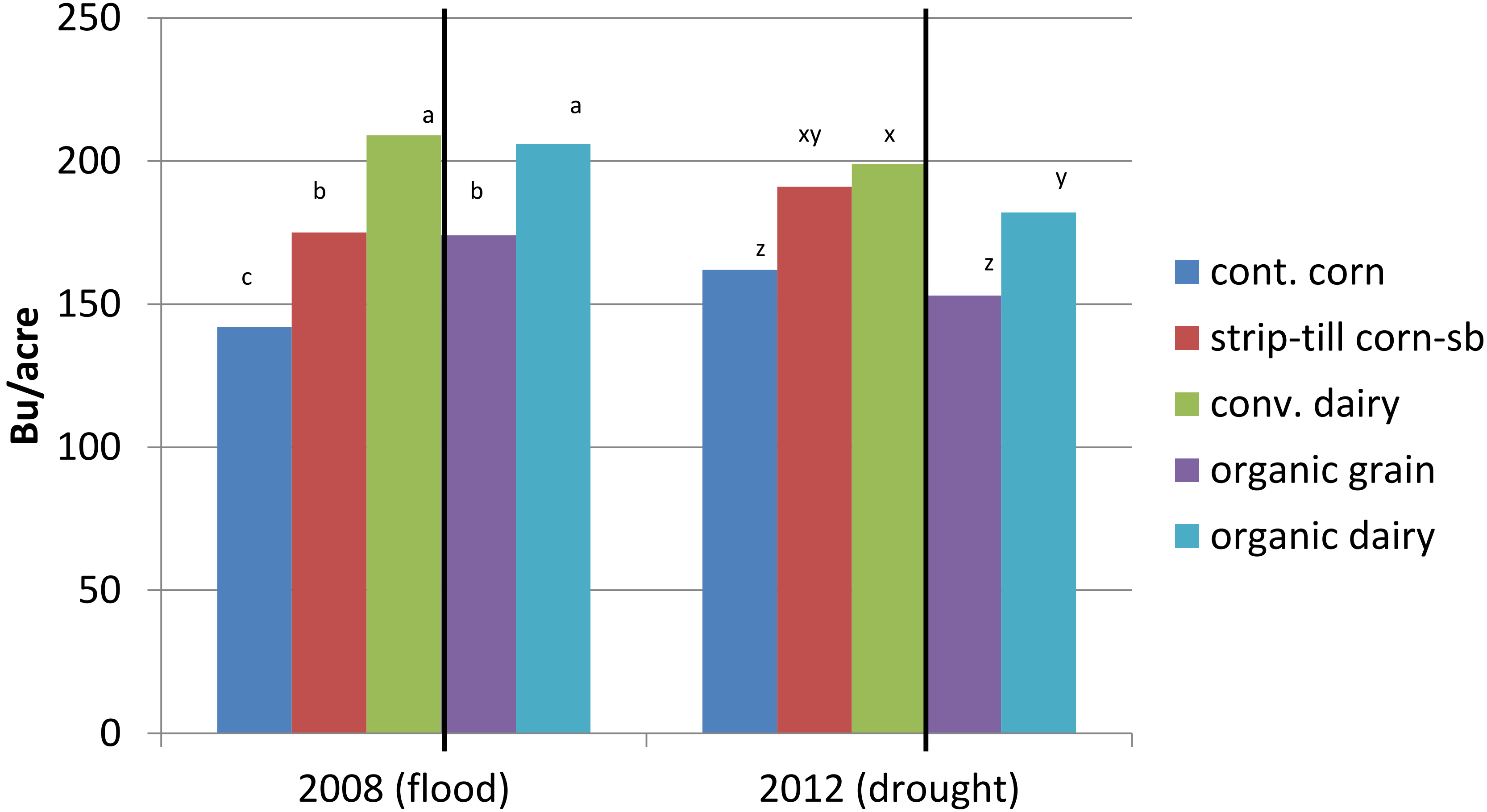
| | Wet Springs (May + June >10" rain) | | Normal Springs | |
|---|---|---|---|---|
| | ARS | LAC | ARS | LAC |
| | \|------------------------bu/a------------------------------\| | | | |
| Conventional (min-till corn-soybean) | 160 | 137 | 173 | 132 |
| Organic (3-yr grain) | 115 | 103 | 167 | 124 |
| Org:conv | 72% | 76% | 96% | 94% |

# Effect of weed pressure on soybean yields

| | Wet Springs (May + June > 10” rain) | | Normal Springs | |
|---|---|---|---|---|
| | ARS | LAC | ARS | LAC |
| | \|-----------------------bu/a-------------------------\| | | | |
| Conventional (min-till corn-soybean) | 48 | 57 | 57 | 53 |
| Organic (3-yr grain) | 38 | 44 | 54 | 49 |
| Org:conv | 79% | 76% | 95% | 92% |


30’ rotary hoe or tine weeder
can do ~ 30 acres/hr

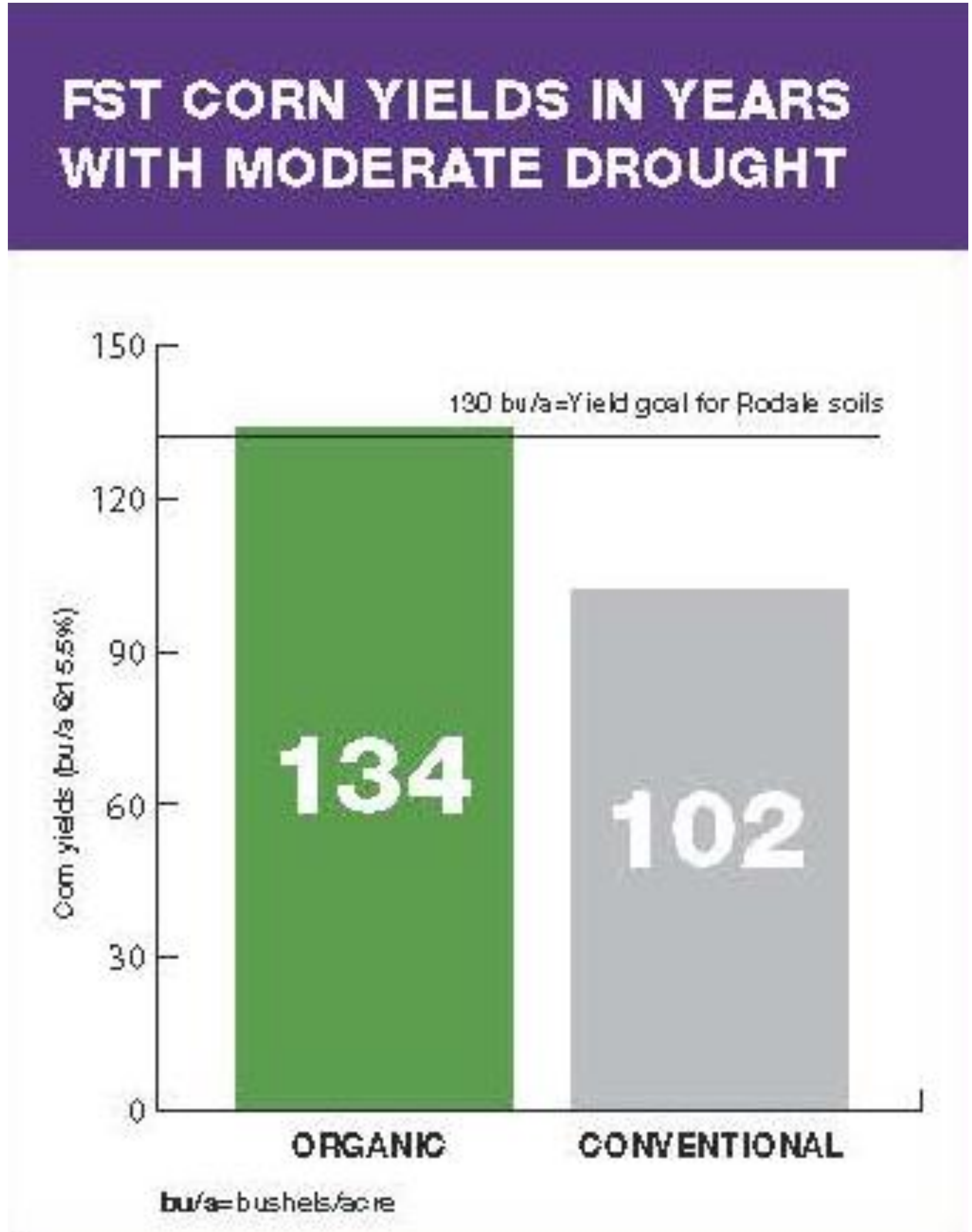
# Corn yields in extreme weather yrs



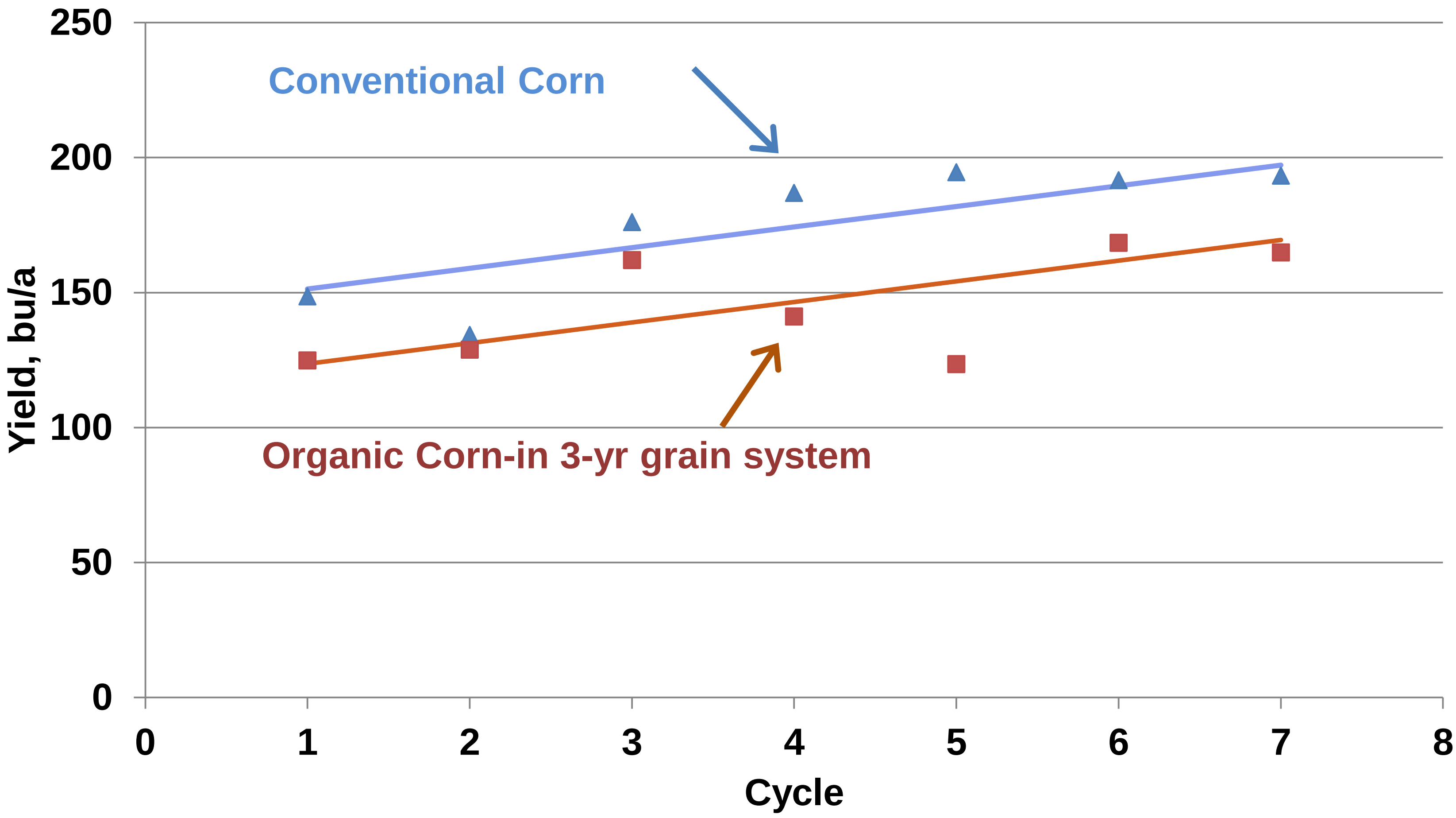
# Rodale

- Corn in the legume-based (left) and conventional (right) plots six weeks after planting during the
- 1995 drought. The conventional corn
- is showing signs of water stress.

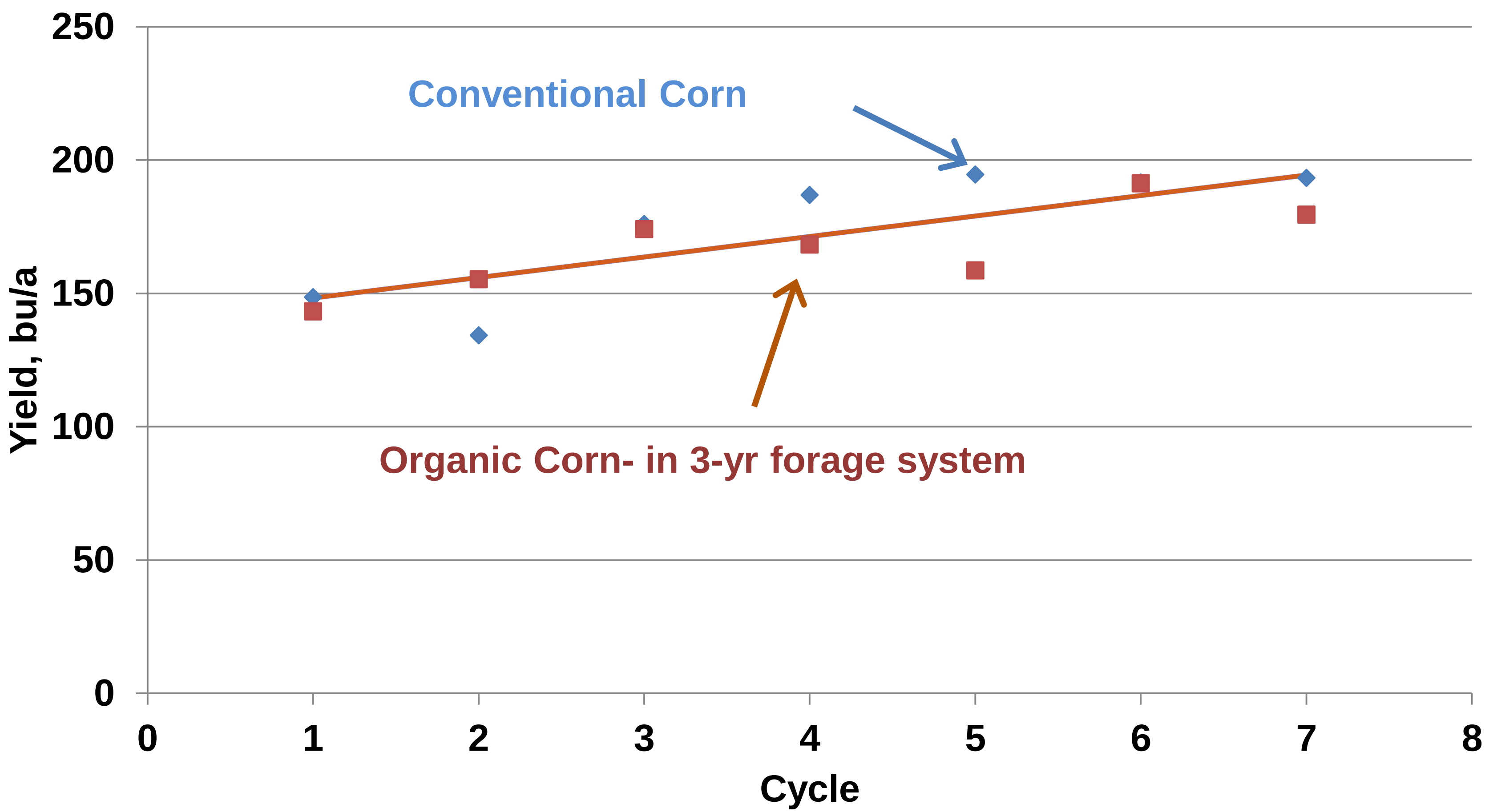
- Rodale -Organic corn yields were 31% higher than conventional in years  of drought



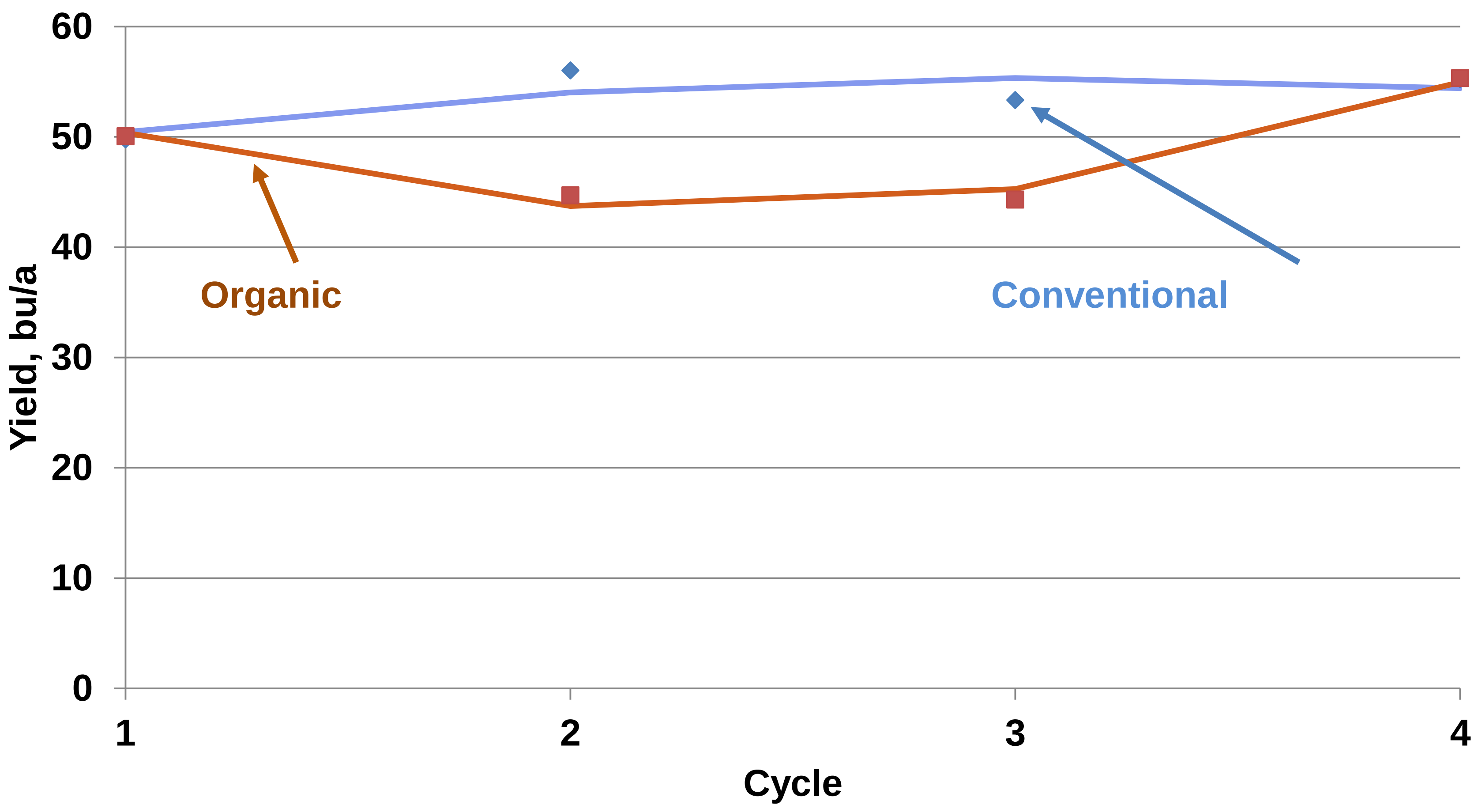
# Conventional vs. Organic Corn Yield Trends



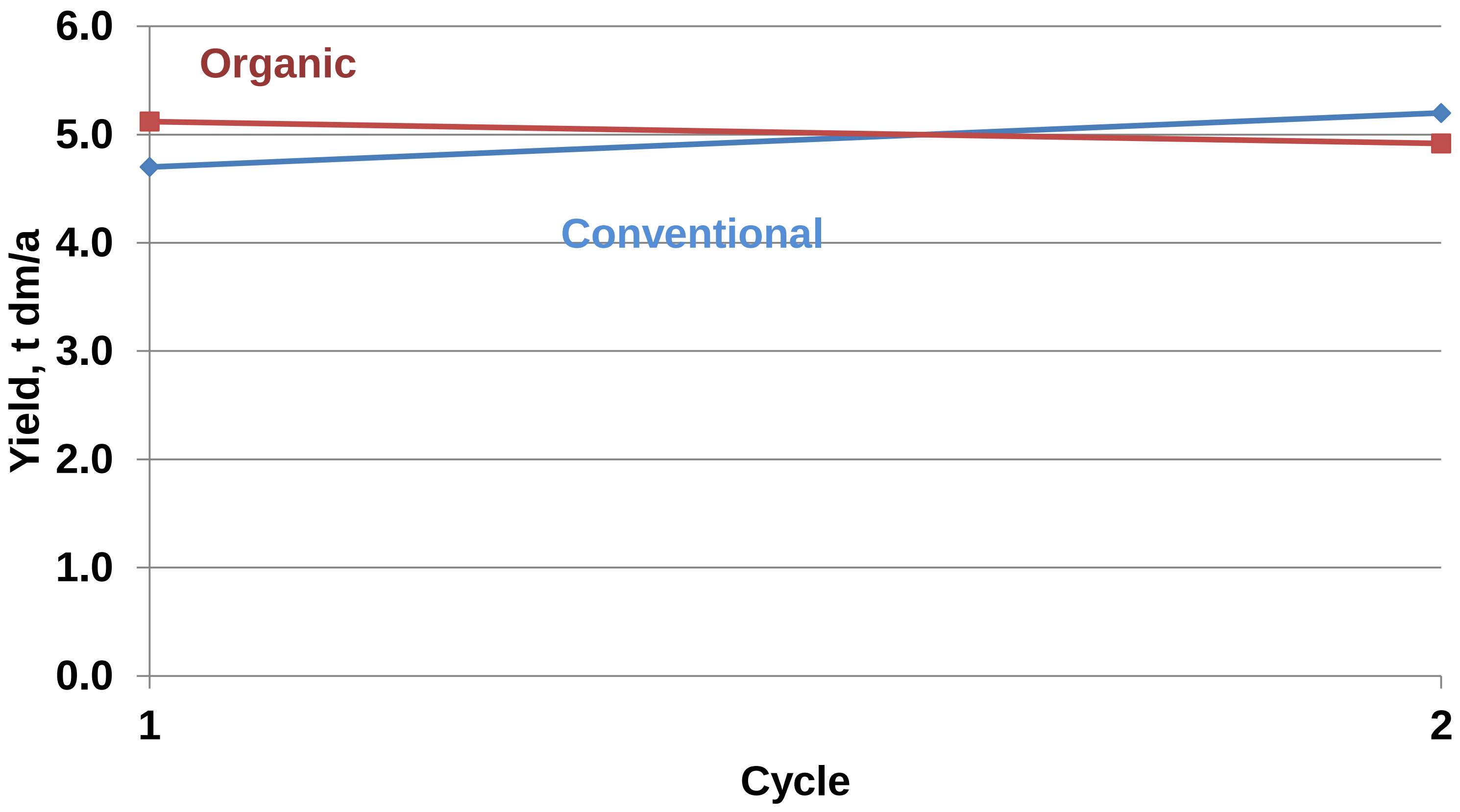
# Conventional vs. Organic Corn Yield Trends



# Conventional vs. Organic Soybeans



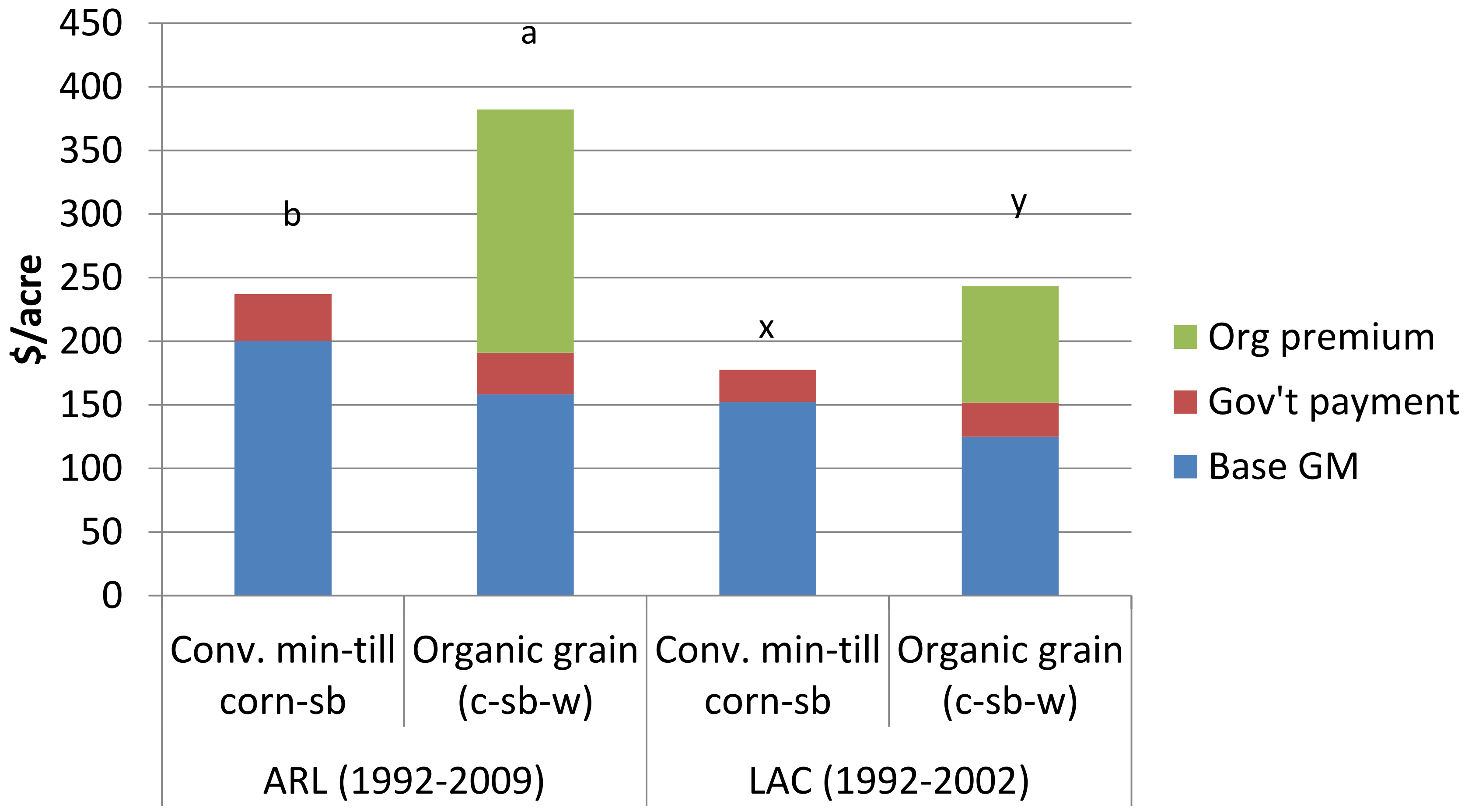
# Conventional vs. Organic Alfalfa



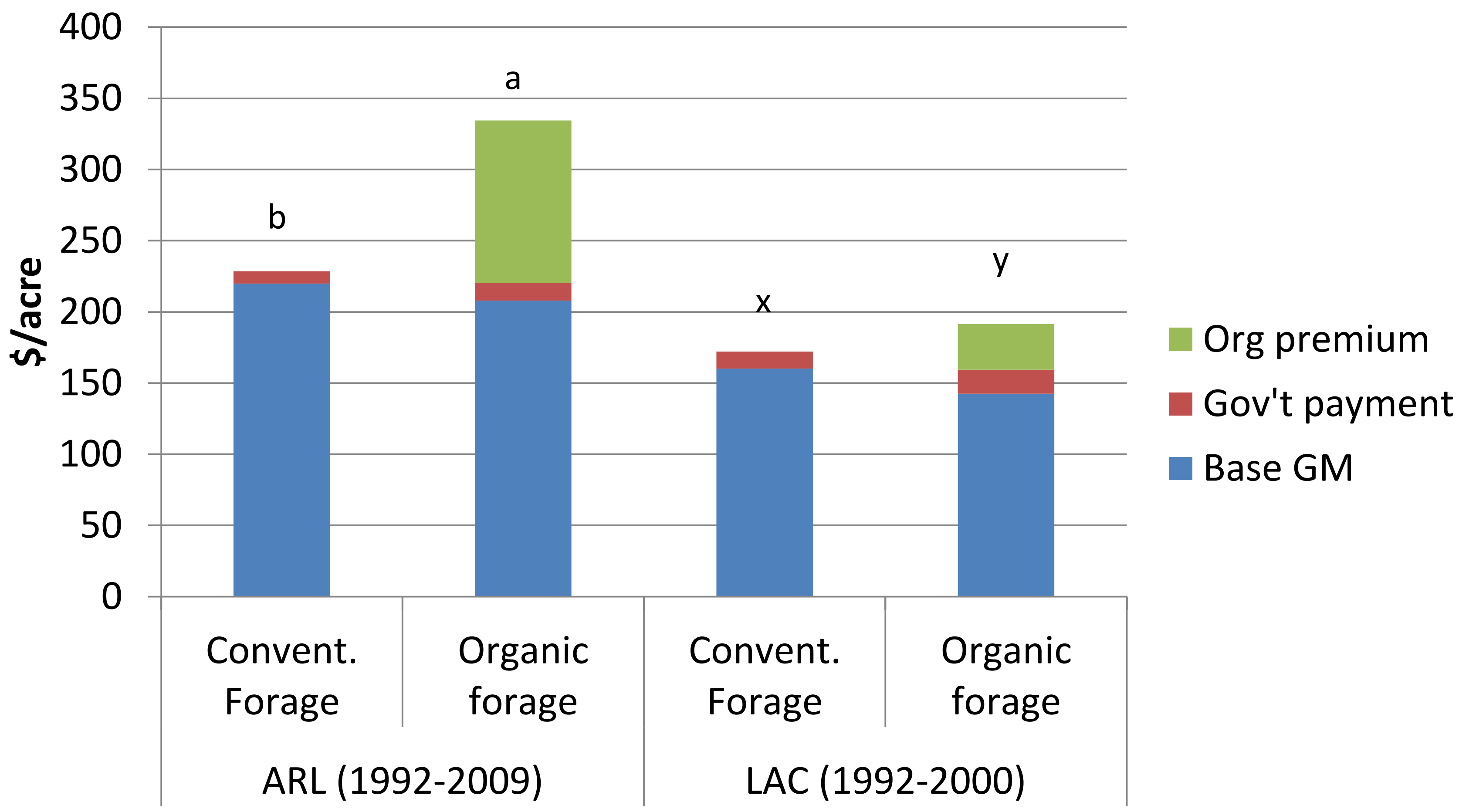
# Base Gross Margins (GM)

- GM = Crop revenue – variable costs
- Grain priced at harvest; hay priced in winter
- Gov't payments included
- Feed-grade organic premiums included
- Systems scaled up to farm size
  - 1200 acres for conventional grain farms
  - 600 acres for organic grain farm
  - 150 acres of conventional and organic forage farms

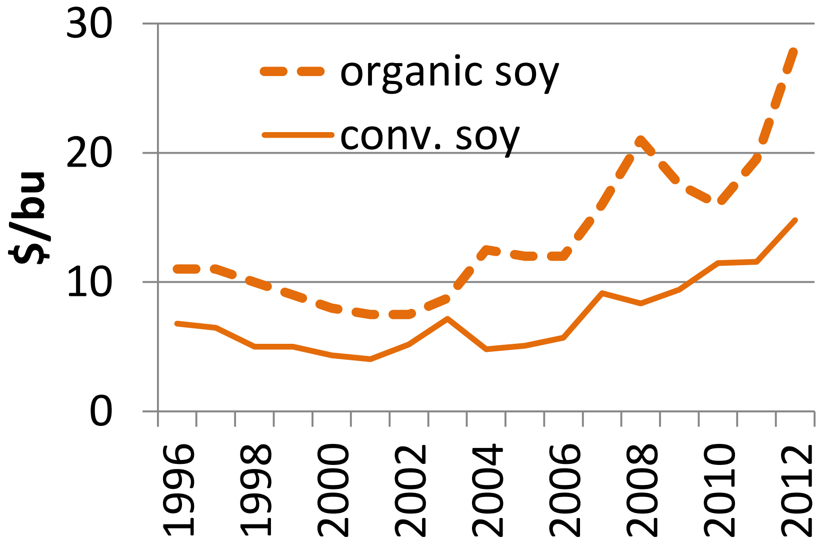
# Historic GM of grain systems

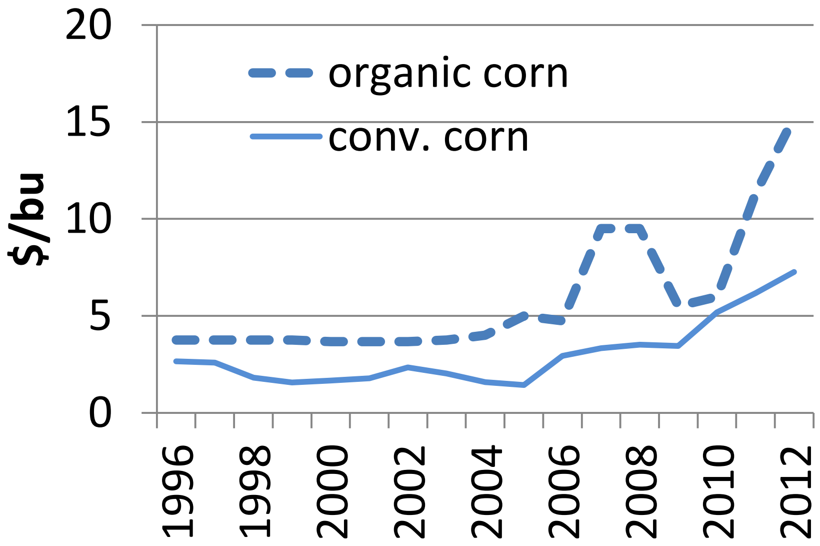


# Historic GM of forage systems

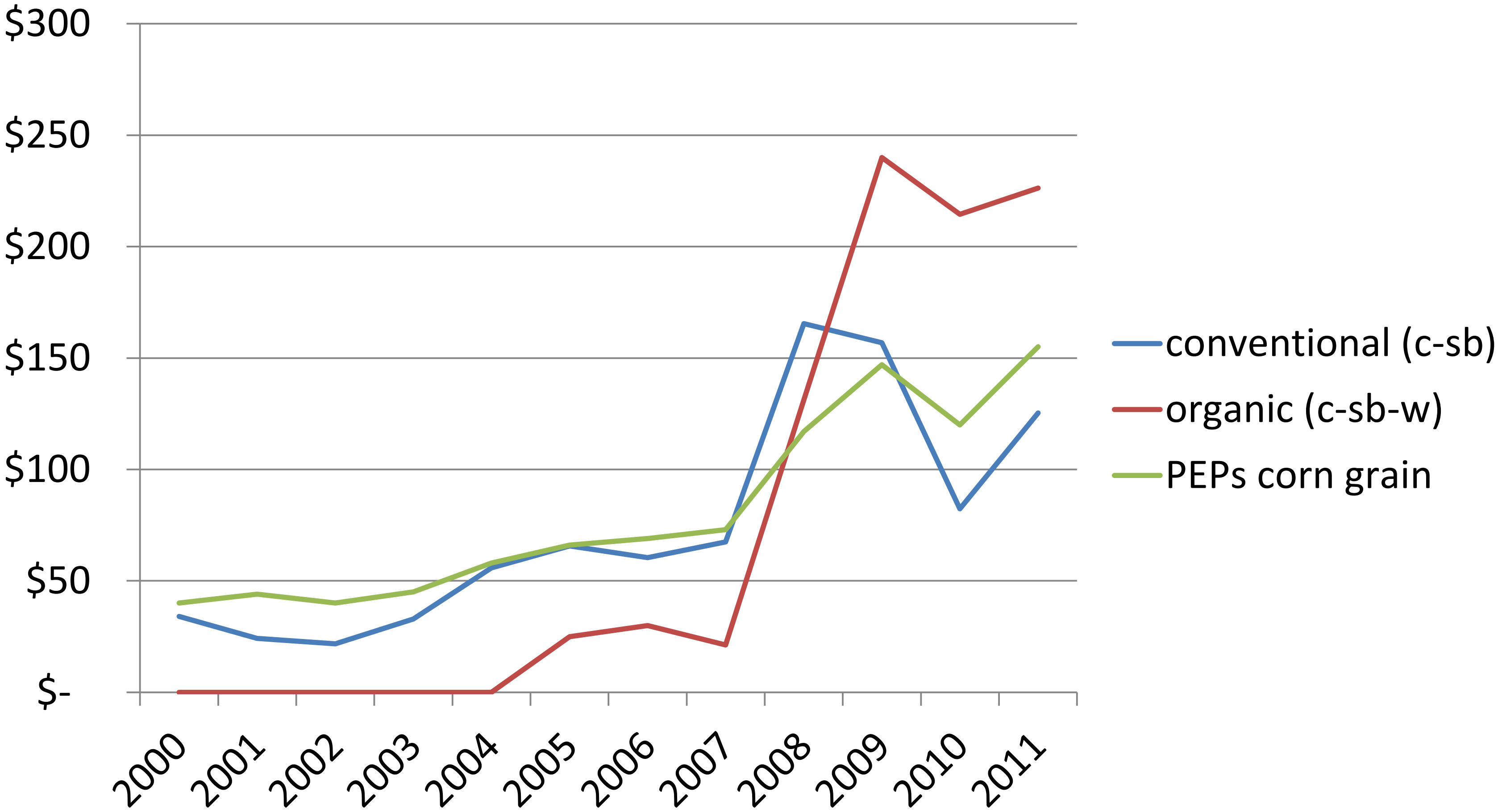


# Corn and soybean feed-price trends (at harvest)

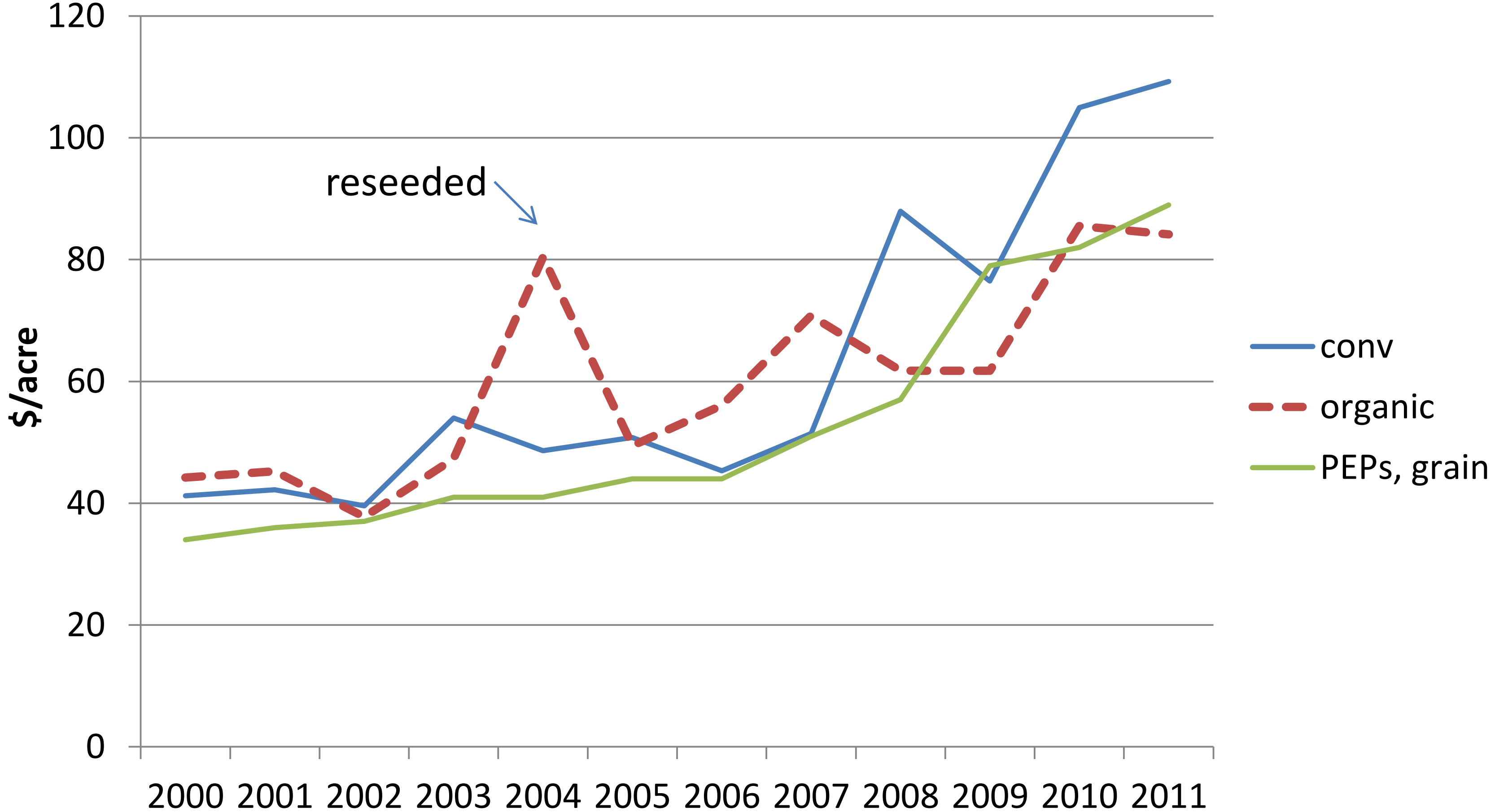


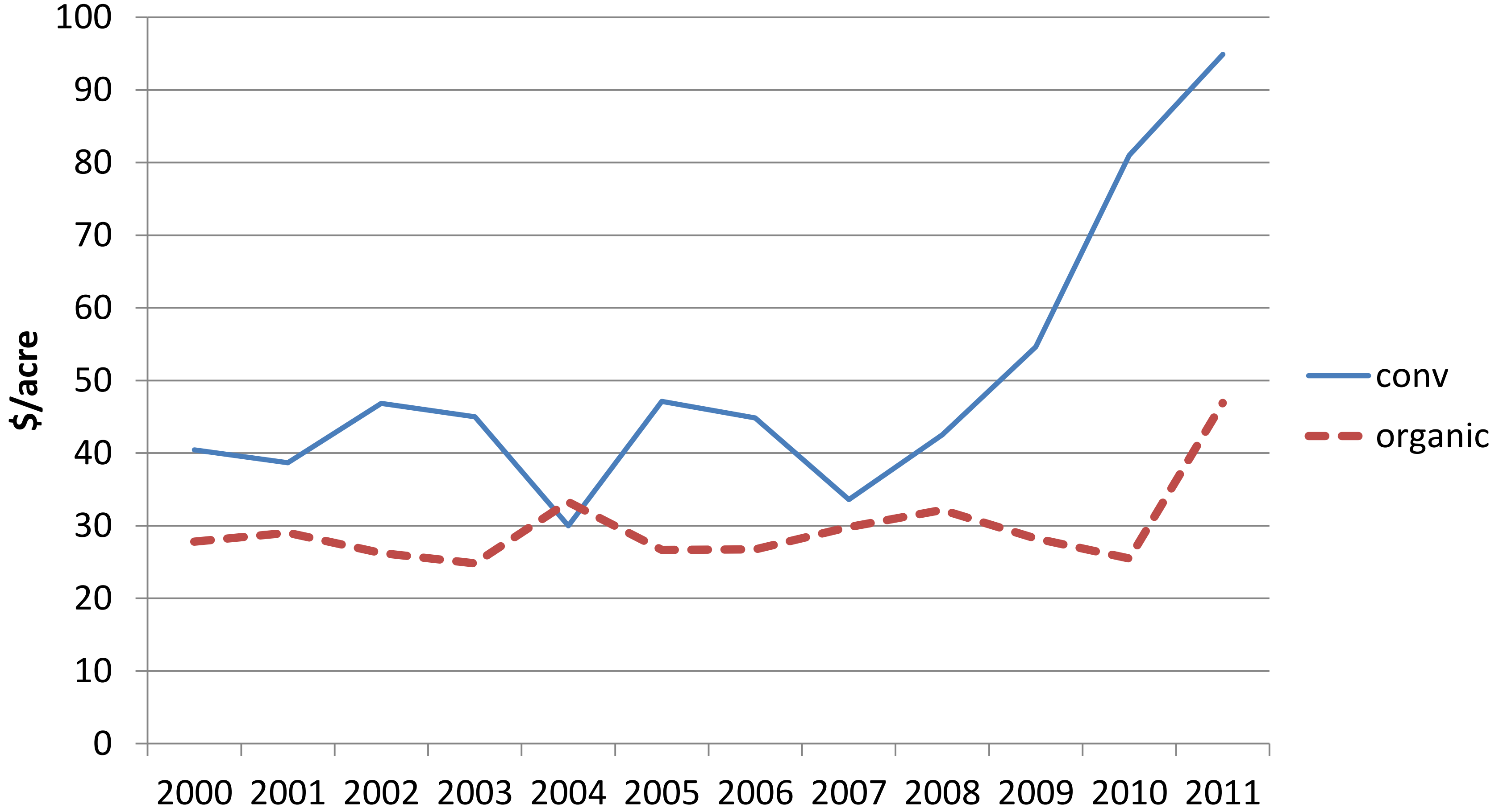
# Fertilizer cost in corn phase at ARL ($/acre)



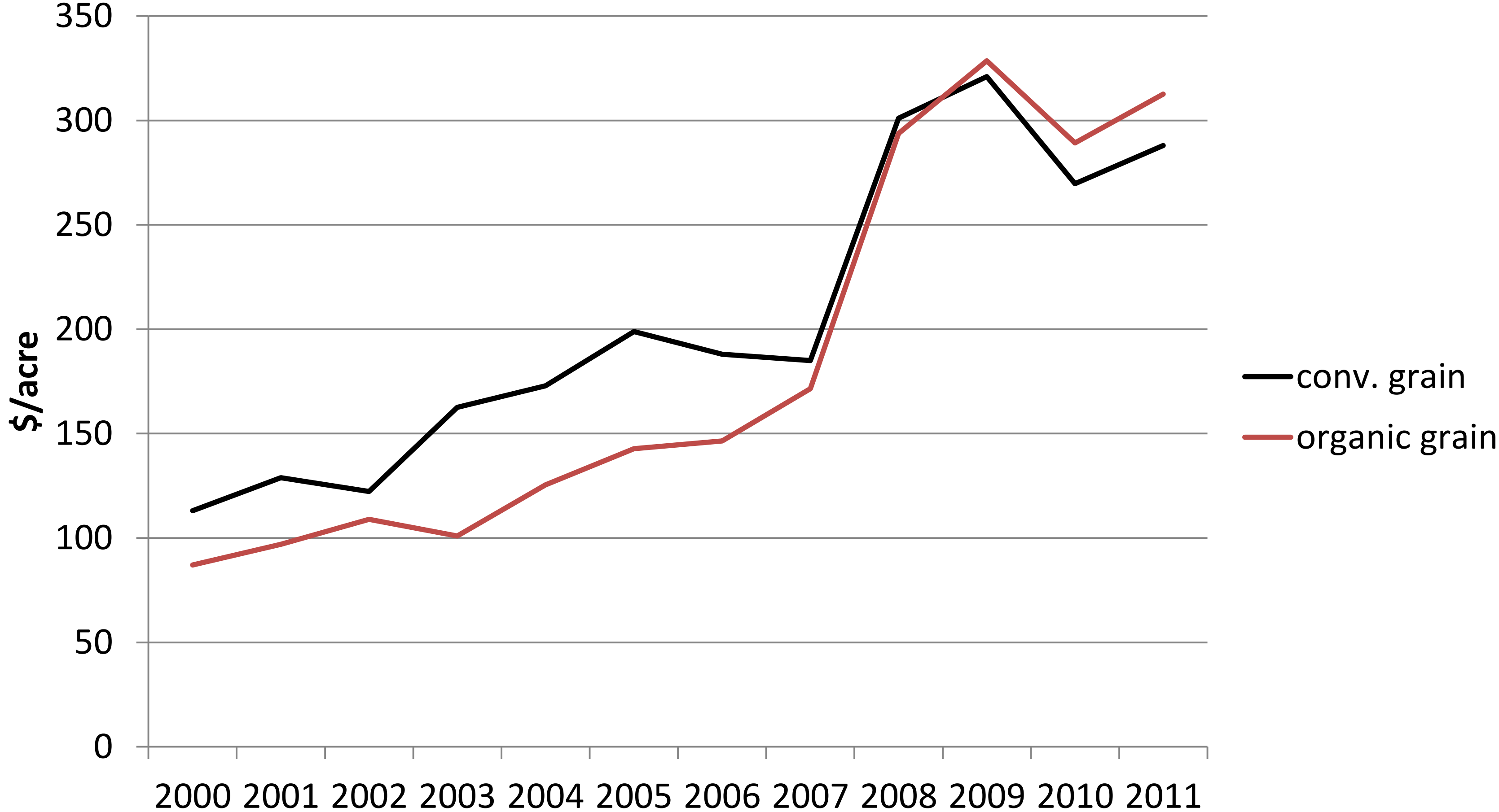
# Corn seeding cost at ARL ($/acre)



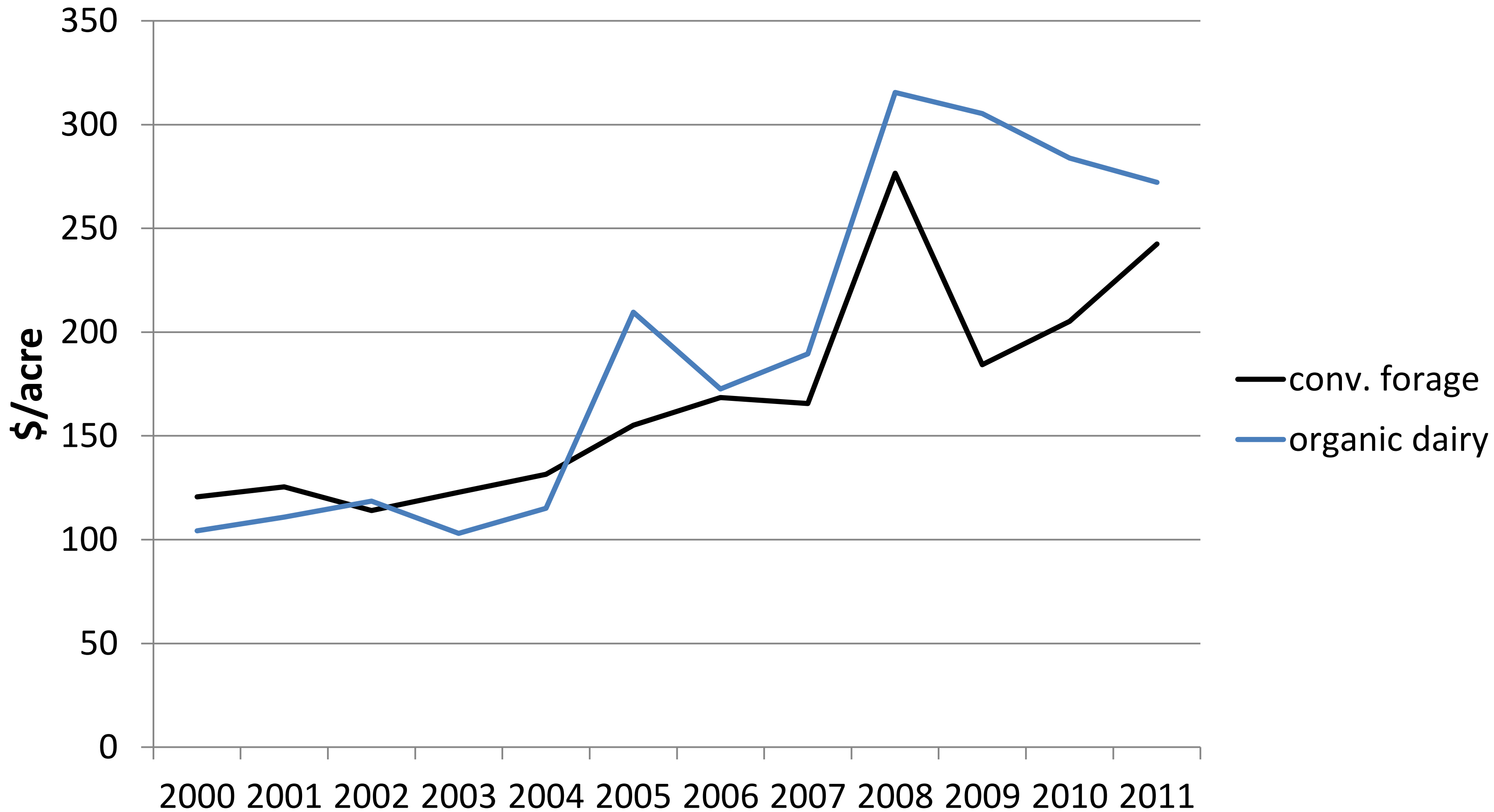
# Soybean seeding cost at ARL ($/acre)



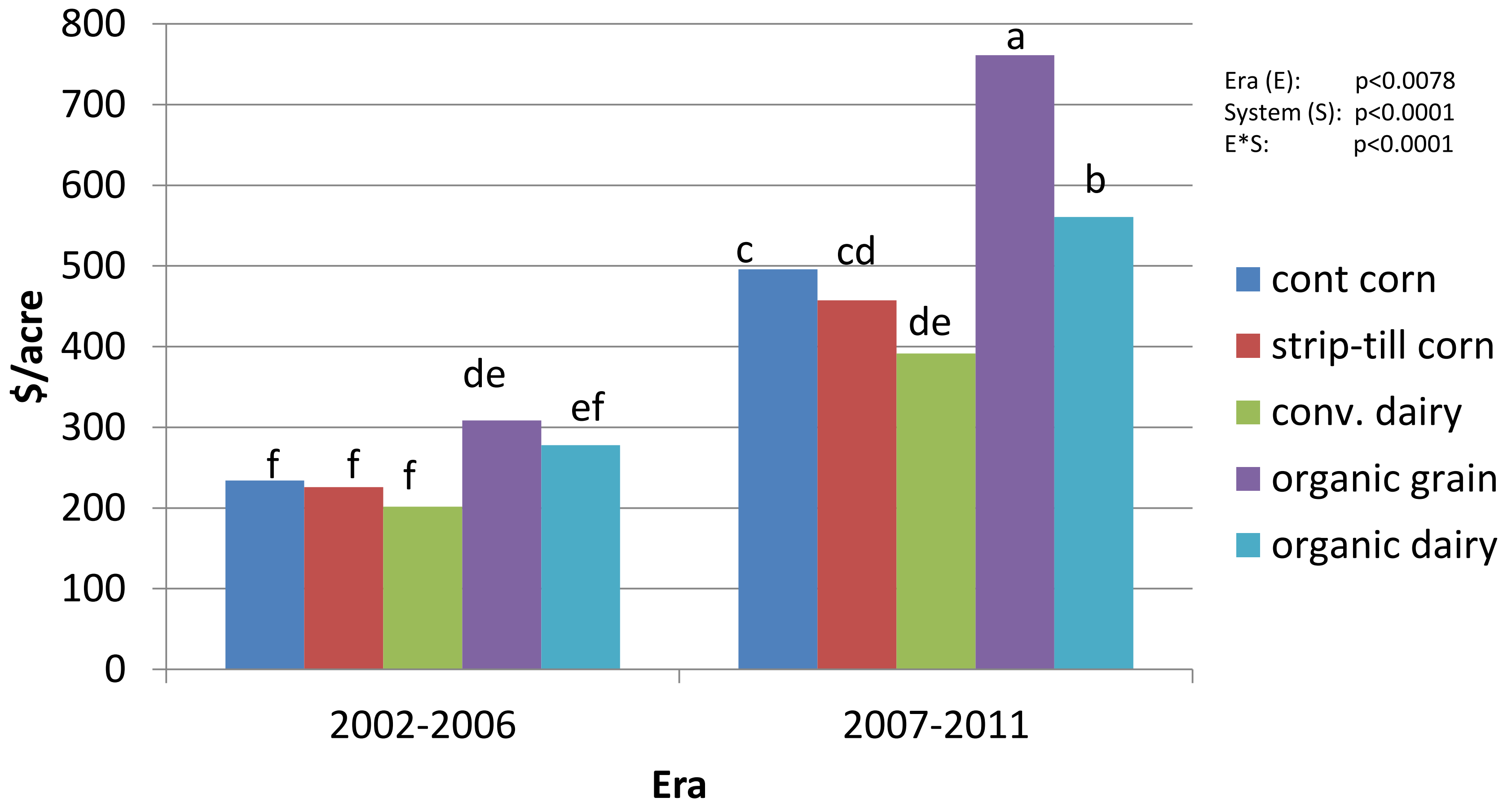
# Total expense in grain systems (ARL)



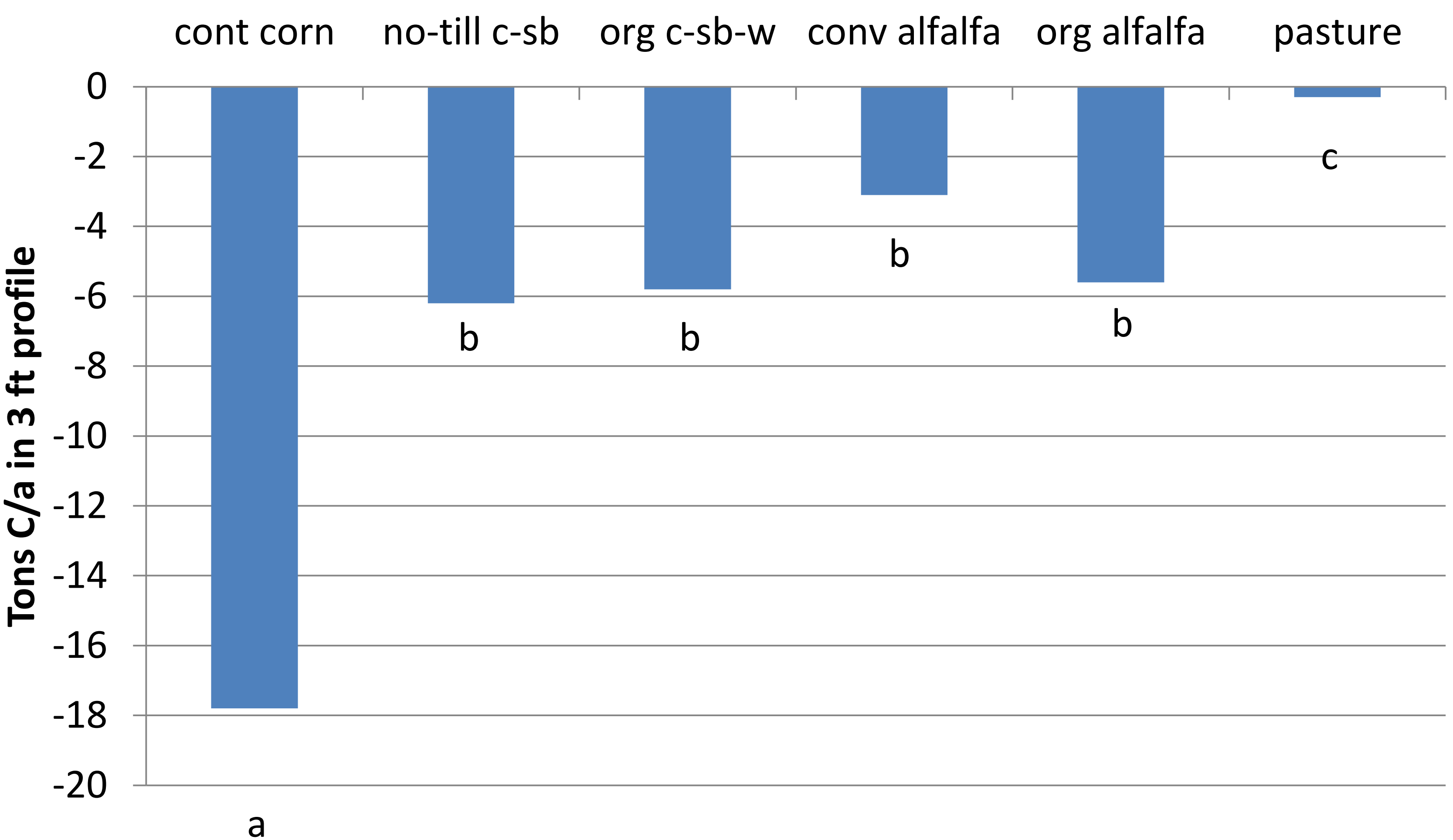
# Total expense in forage systems (ARL)



# Gross margins in 2000 decade-ARL



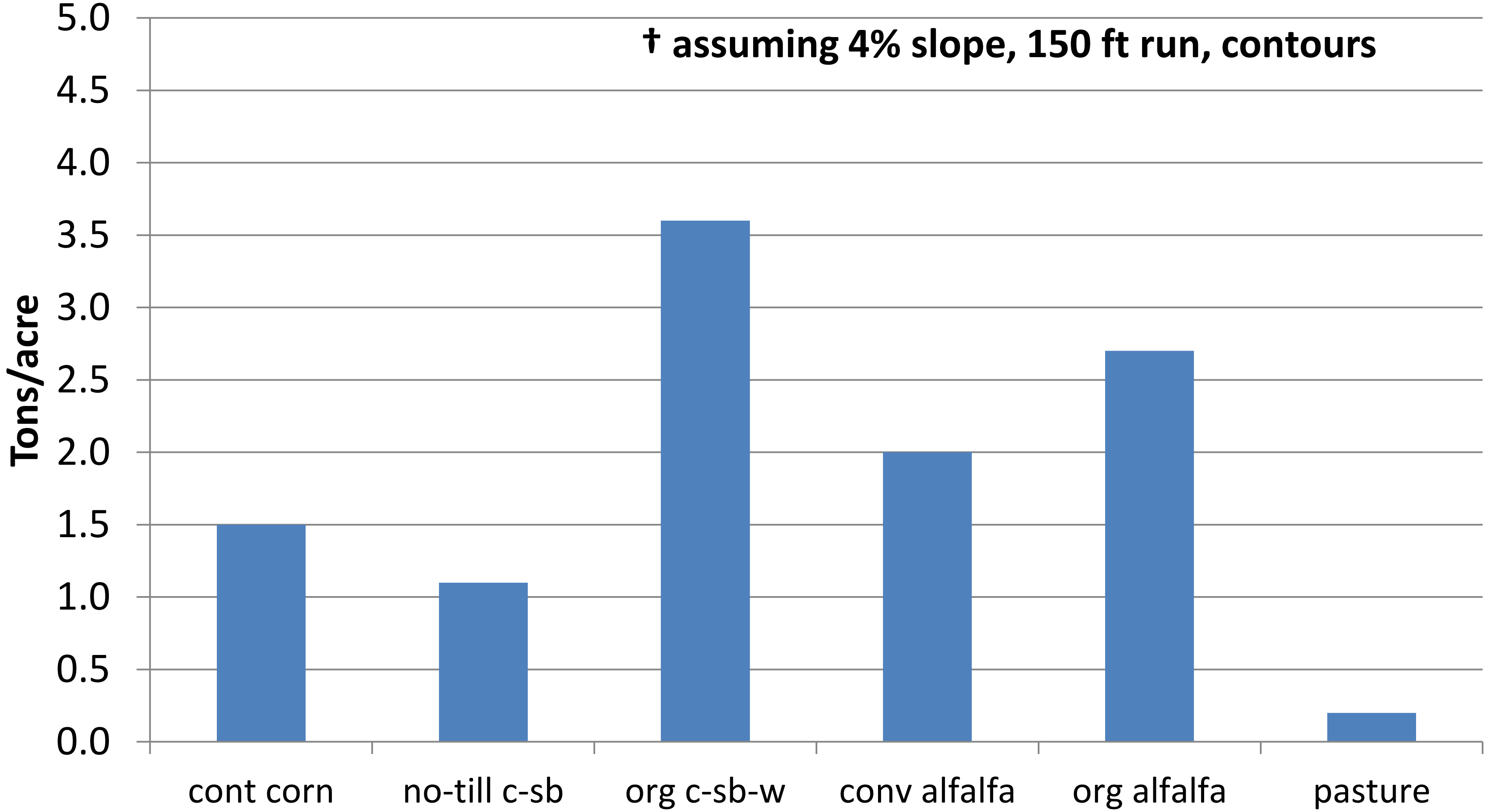
# Soil Organic C changes over 20 yrs-ARL



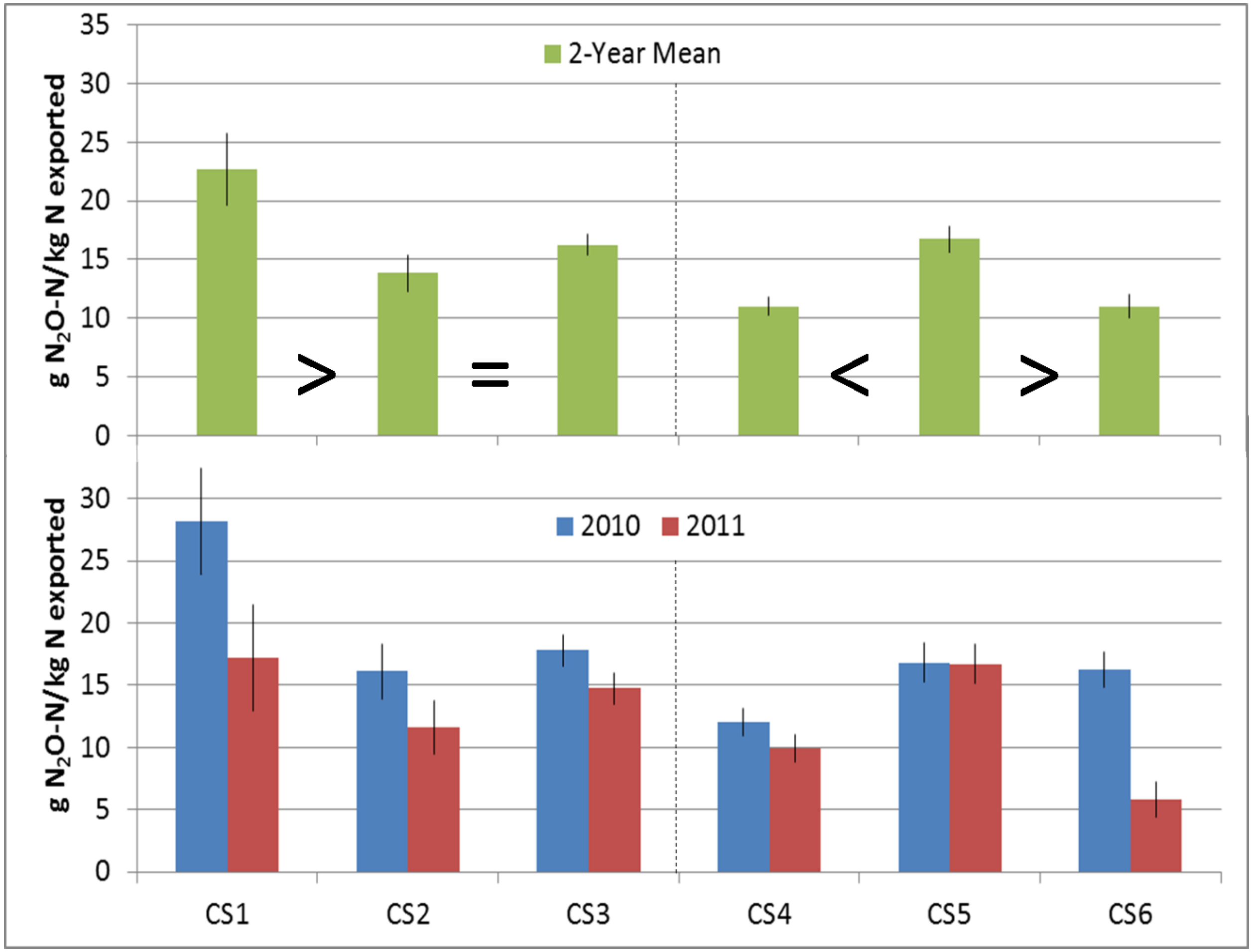
# Soil C inputs on WICST

| | ARL ('92-'09) | LAC ('92-'02) |
|---|---|---|
| System | lbs C/acre$^{-1}$ | |
| Cont. corn | 5390 | 3301 |
| Min-till corn-sb | 4081 | 3324 |
| Org grain (c-sb-w) | 3038 | 2297 |
| Conv. Forage | 6075 | 6353 |
| Organic Forage | 6377 | 7145 |
| Pasture with managed grazing | 5380 | 5548 |

# RUSLE2 Soil loss estimates† (18-yr avg, ARL)

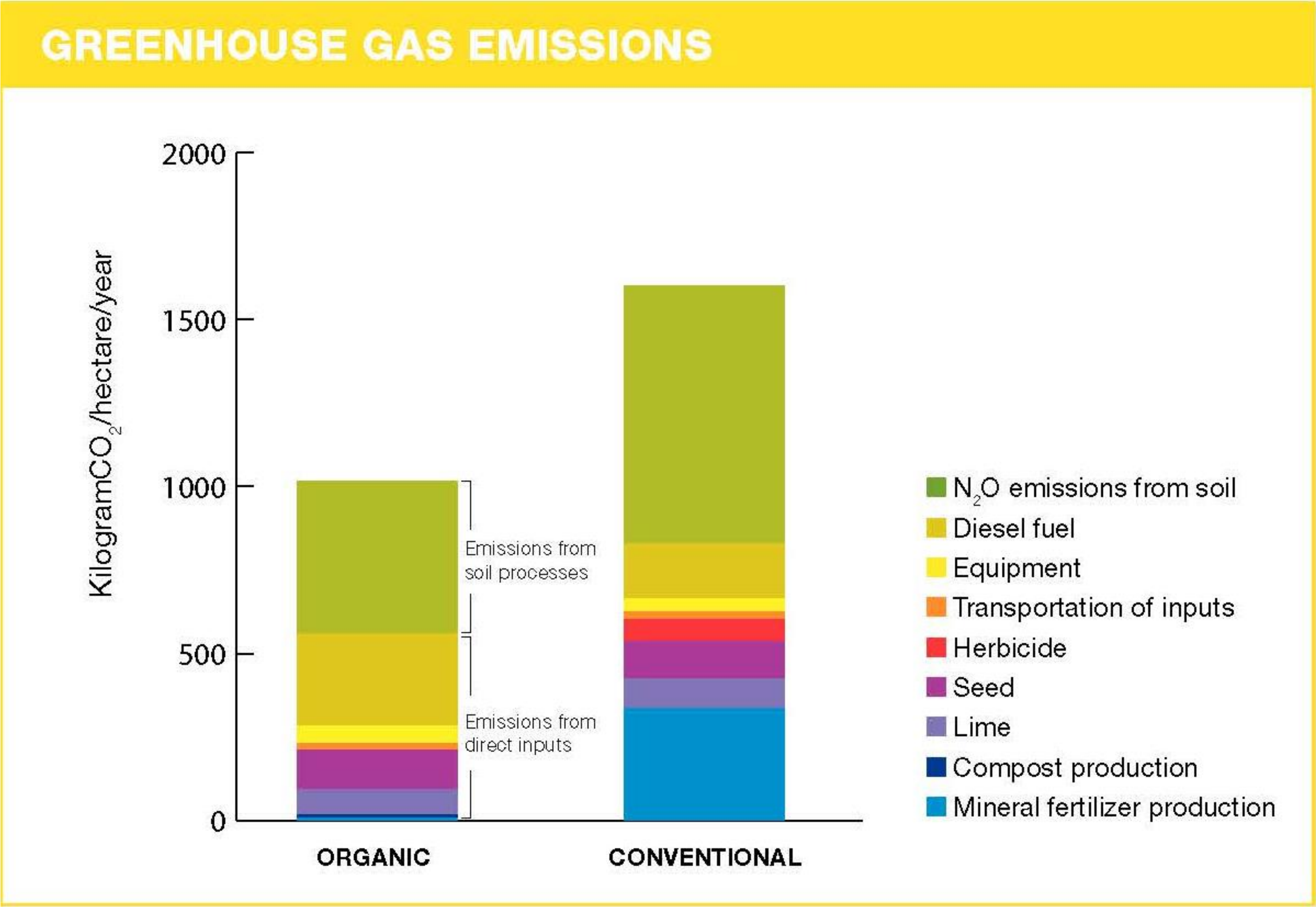


# $N_2O$ emissions/unit of N harvested-ARL



# C and N changes in other Long-Term Studies

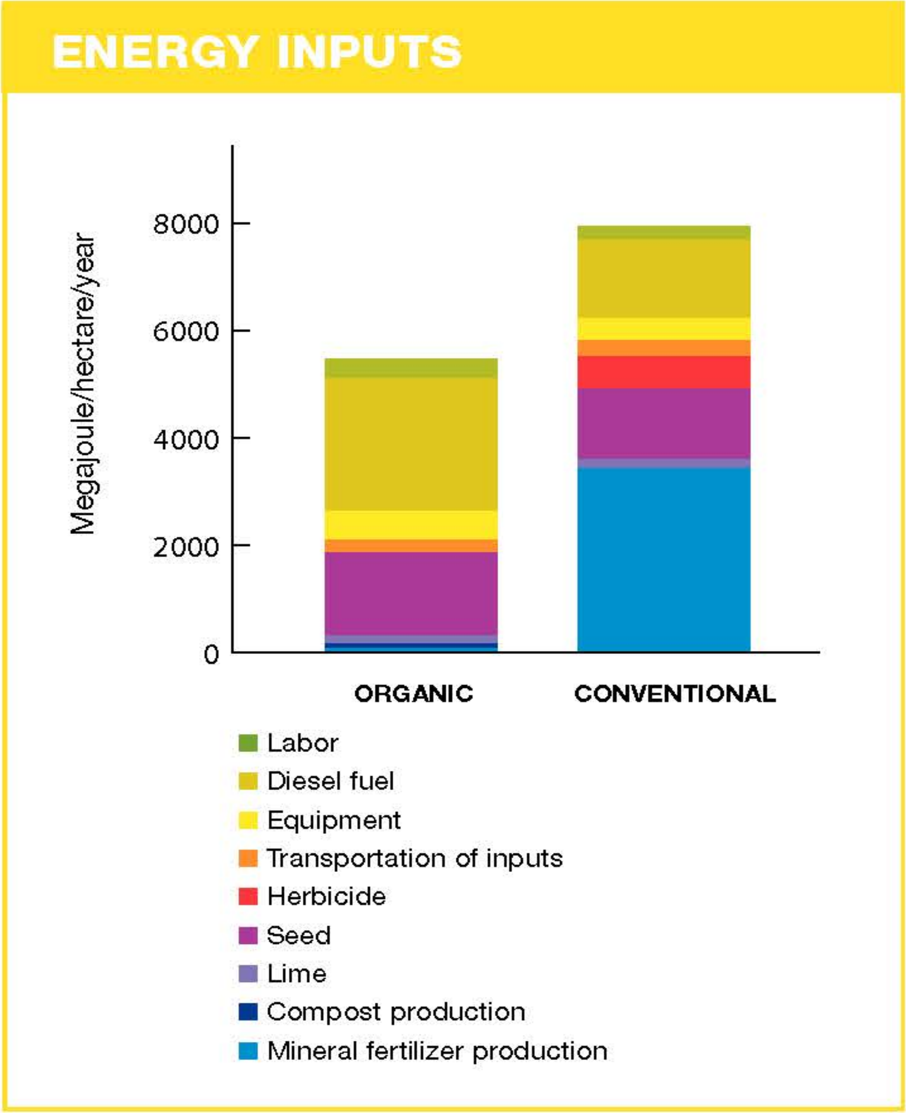
- LTAR (Iowa) - Total nitrogen increased by 33 percent in the organic plots
  - higher concentrations of carbon, potassium, phosphorous, magnesium and calcium
  - results suggest that organic farming can foster greater efficiency in nutrient use and higher potential for sequestrating carbon

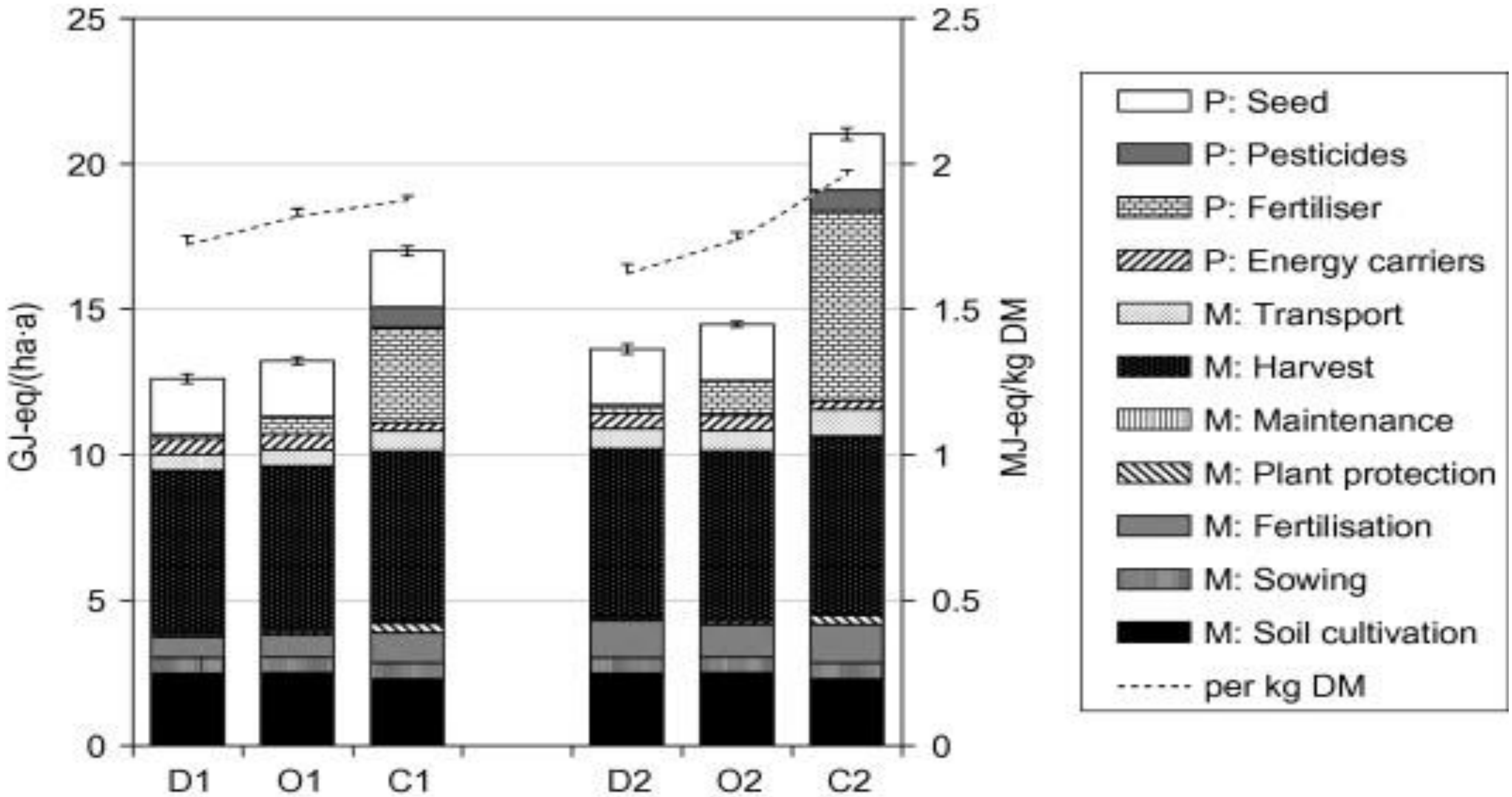



- Rodale FST - in both organic and conventional systems, the highest overall GHG emissions were caused by soil processes fueled by nitrogen fertilizer, compost, and crop residues

# Rodale FST

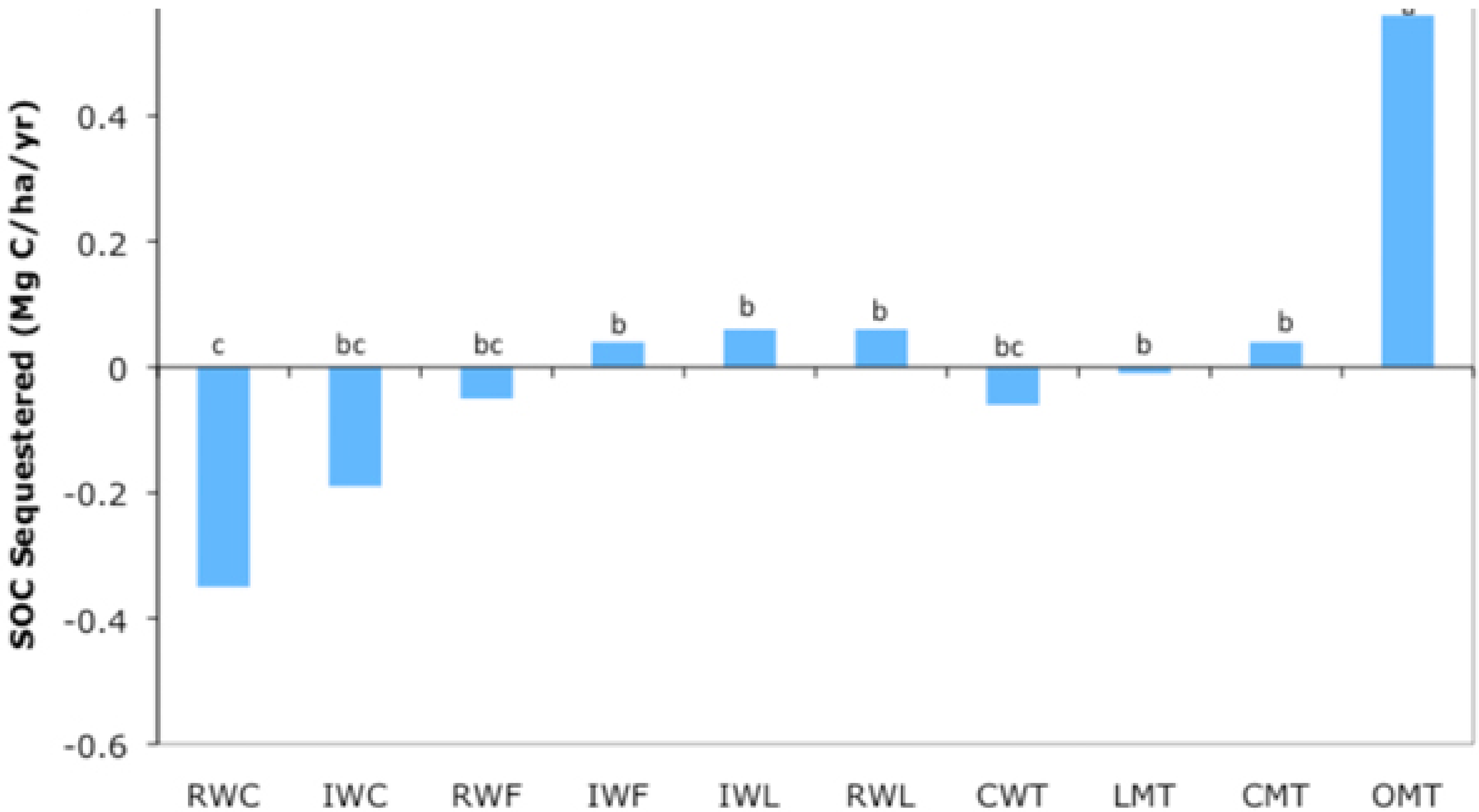
- Organic system uses 45% less energy – mainly from not allowing conventional fertilizers






- Demand for non-renewable energy resources of the farming systems in the DOC experiment (1985–1998) per hectare and year (columns) and per kg dry matter (DM, line)(Nemecek et al., 2011)

# LTRAS (California)




http://asi.ucdavis.edu/programs/rr/research/carbon-sequestration-and-soil-organic-carbon

# Conclusions

- Yields: Org:Conv >90% when weeds controlled
- Organic yields better than continuous GM corn in extreme weather years
- Organic yields similar to rotated GM corn in extreme weather years
- Yield trends
  - Corn increased at 2.5 bu/a/yr (same for organic and conventional)
  - Soybeans had slight gain at 0.2 bu/a/yr (same for organic and conventional)
  - Alfalfa –no real trend yet

# Conclusion (cont'd)

- Profitability: organic >conventional
  - Gross margin higher in last 5 yrs. vs. previous 5 yr
  - Large part of the profitability is coming from strong and steady premiums (in this study feed premiums)
  - Inputs (seed, fuel, and nutrients) are driving up expenses, often near to the cost of conventional inputs
- Ecosystem Services
  - All systems losing carbon other than pasture
  - Expand rotation with alfalfa can reduce soil loss
  - GHG lower under rotations but not necessary due to organic management

Find the slides and recording of this presentation at
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