The Profitability of Organic Agriculture: Lessons from the Sustainable Agriculture Farming Systems Project (SAFS)

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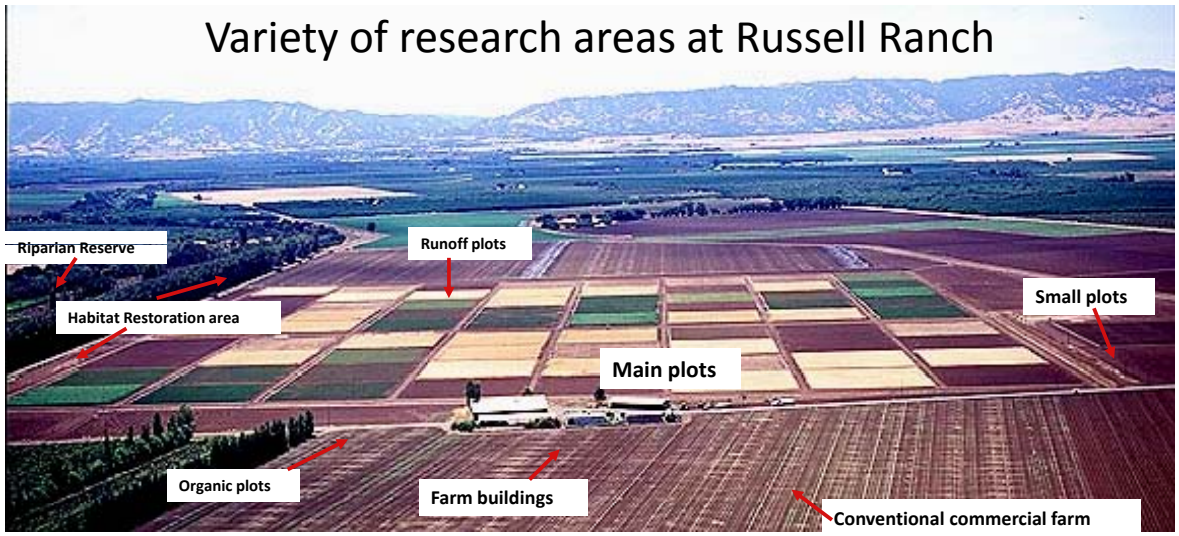
Variety of research areas at Russell Ranch

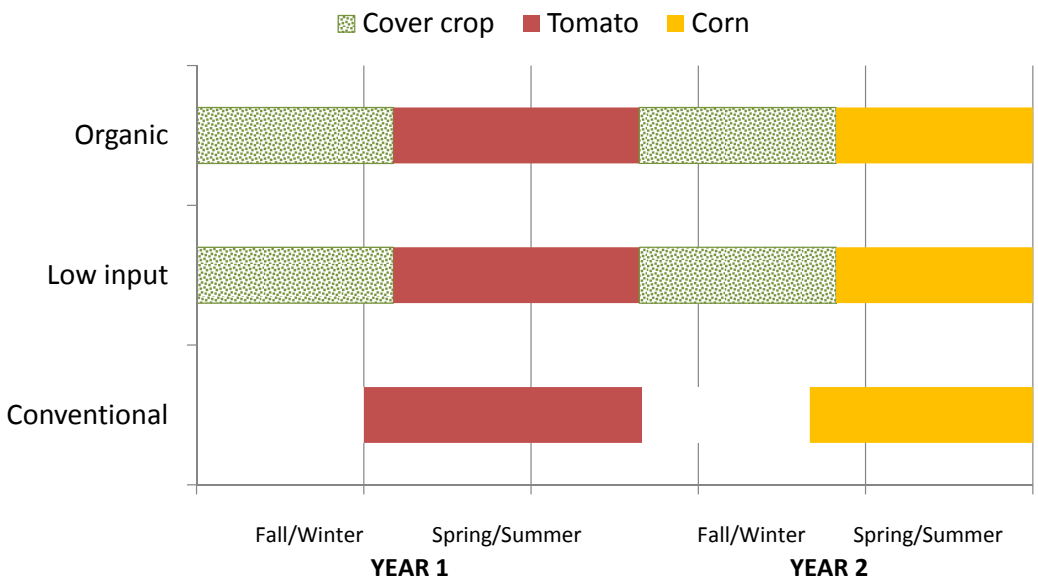


- Small plots for shorter term investigations: e.g., comparison of cover crop mixes, biofuels crops, impact of continuous cover on soil biology, comparison of drip vs furrow irrigation
- Runoff plots: impact of management on runoff of nutrients and pesticides
- Large plots under organic management, currently unassigned
- Conventional commercial farm: surrounding land leased by neighboring grower, managed conventionally
- Habitat restoration area (as mitigation for UC Davis development)
- Putah Creek Riparian Reserve adjacent to Russell Ranch

Russell Ranch / SAFS History

Years	Events
1992 – 1993	Russell Ranch purchased by UC Davis Irrigated, unfertilized Sudan grass planted to create uniform soil fertility conditions
1994 - 2007	Two-year rotations of processing tomato and corn & others Organic, low input, and conventional Each system/crop combination each year
2003	SAFS relocates to Russell Ranch from Vegetable Crops facility
2003 - 2007	Each system split into conservation tillage and standard tillage
2008 - present	Two-year rotations of processing tomato and wheat Organic, low input, and conventional All systems are conservation tillage

SAFS Systems and Rotations



PRODUCTION PRACTICES AT SAFS

Tomato Preplant Operations

	Organic	Conventional
October/ November	Mow residue Plant cover crop	Mow residue Subsoil, disc, roll, triplane Prepare beds
December		
January		Spray weeds
February		
March		Spray weeds
April	Mow cover crop Apply compost Ground prep Make beds	Smooth beds Starter fertilizer
May	Transplant	Transplant Sidedress fertilizer

Tomato bed management

1. Strip till
2. Full bed mulch
3. Strip till detail

Fertility

	Organic	TOMATO Low Input	Conventional
Cover crop	1994 - 2006	2004 – 2006 only	
Chicken manure	Rates reduced after 1997		
Synthetic N	None	1994 – 2003 = conv 2004 – 2006 reduced	15-15-15, ammonium sulfate

	Organic	CORN Low Input	Conventional
Cover crop	1994 - 2006	1994 - 2006	
Chicken manure	Same as tomato		
Synthetic N	None	None	Urea

Fertility - 2007

	Organic	TOMATO Low Input	Conventional
Cover crop	Bell beans/vetch	Bell beans/vetch	
Poultry compost	4 tons		
Synthetic N		Preplant 15 – 15 -15 @ 45 lbs.	Preplant 15-15-15 @ 45 lbs. Sidedress 21-0-0-24 @100 lbs.

	Organic	CORN Low Input	Conventional
Cover crop	Bell beans/vetch	Bell beans/vetch	
Poultry compost	4 tons		
Synthetic N			Post plant 46-0-0 @ 165 lbs. Sidedress 15-15-15 @ 45 lbs.

Oats/vetch/bell bean mix

Reel chopping cover crop to initiate dry down prior to incorporation

Cover crop and incorporation

2. Bell bean/wheat cover crop
3. Bed disc for full incorporation
4. Flail mowing cover crop

Weed control - 2007

	Organic	TOMATO Low Input	Conventional
Tillage	Strip till 5X Cultivate 4X	Strip till 5X Cultivate 3X	Strip till 2X Cultivate 2X
Hand hoeing	35 hours	11 hours	6 hours
Herbicide		May July	February May July

	Organic	CORN Low Input	Conventional
Tillage	Cultivate 3X	Cultivate 2X	Cultivate 2X
Herbicide		May	February April May

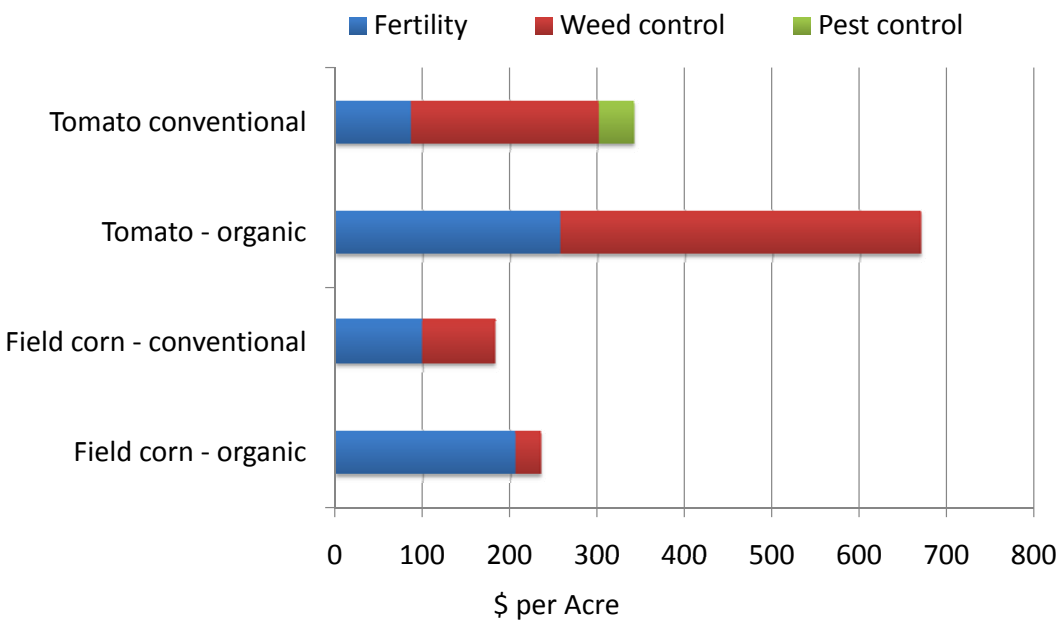
Pest control - 2007

	Organic	TOMATO Low Input	Conventional
Insecticide/Miticide		Oberon 8.5 oz.	Oberon 8.5 oz.
Worms		Sulfur 20 lbs.	Sulfur 20 lbs.

Cultural Costs

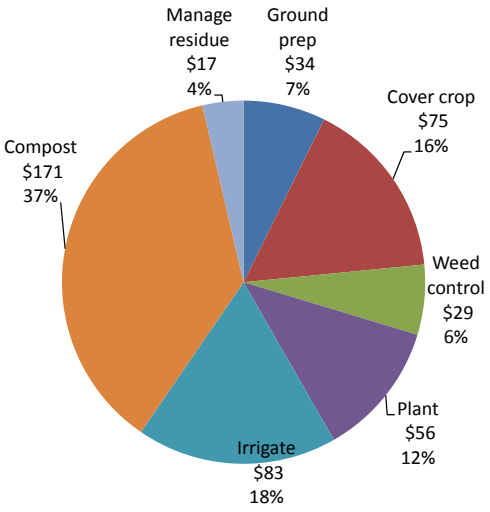
COST OF PRODUCTOIN

Costs of Production by Management Category

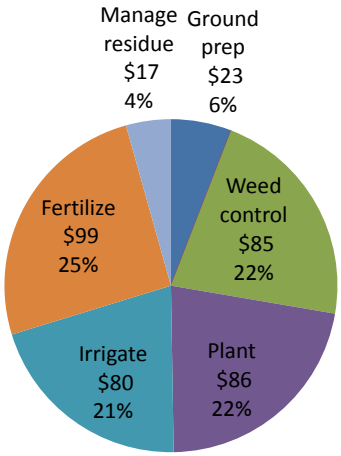


Cost of Production - Corn

Organic - $465/A

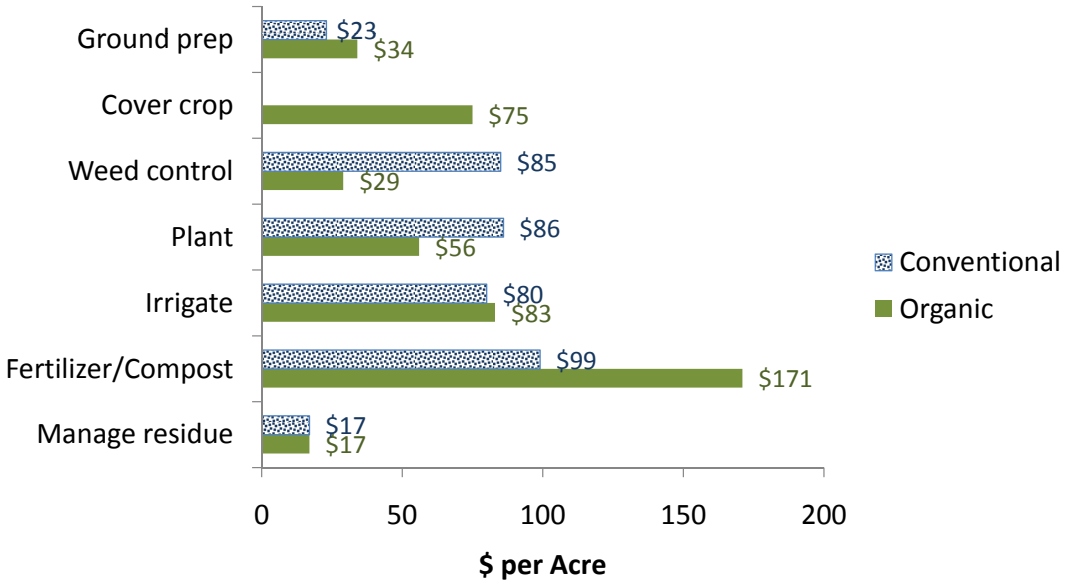


Conventional - $390/A



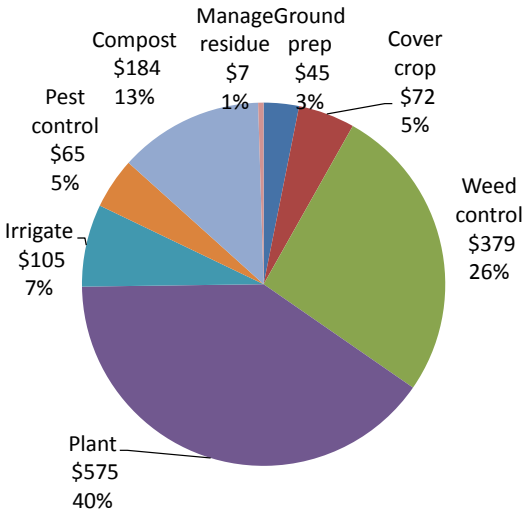
Comparison of Cultural Costs – Corn

Organic $465/A ~ Conventional $390/A

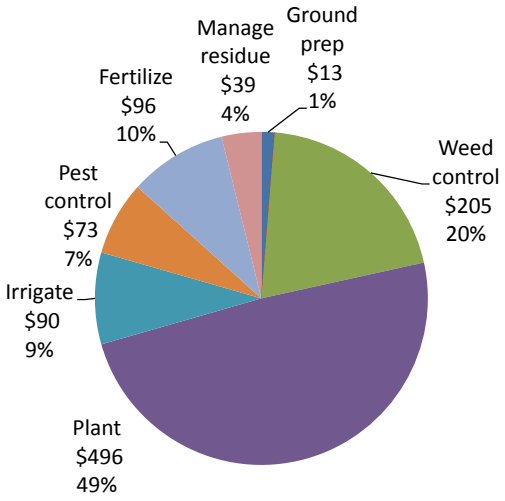


Cost of Production - Tomato

Organic - $1,432/A

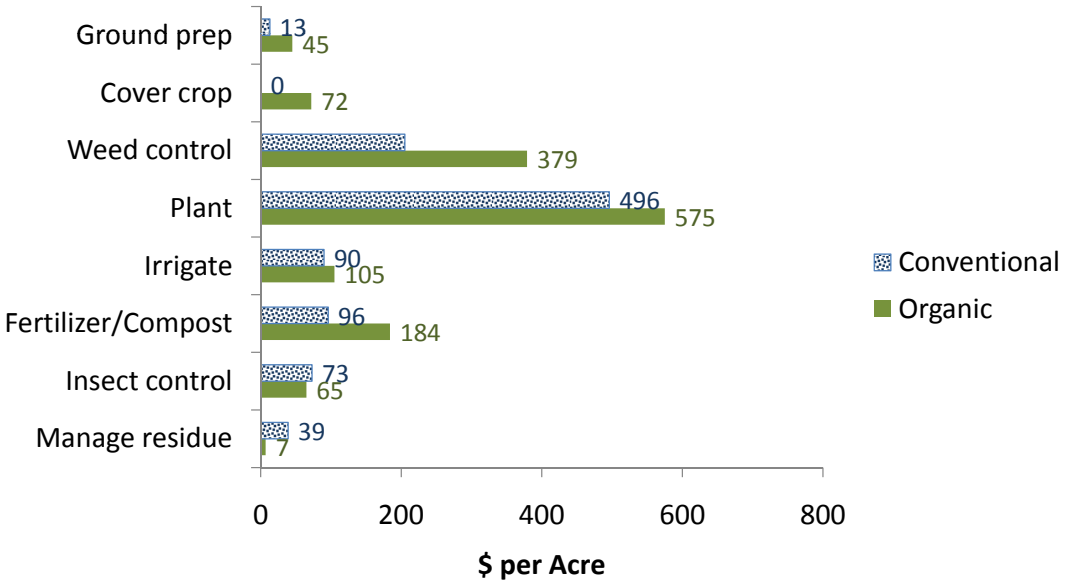


Conventional - $1,012/A



Comparison of Cultural Costs – Tomato

Organic $1,432/A ~ Conventional $1,012/A



Yield and Price

REVENUE

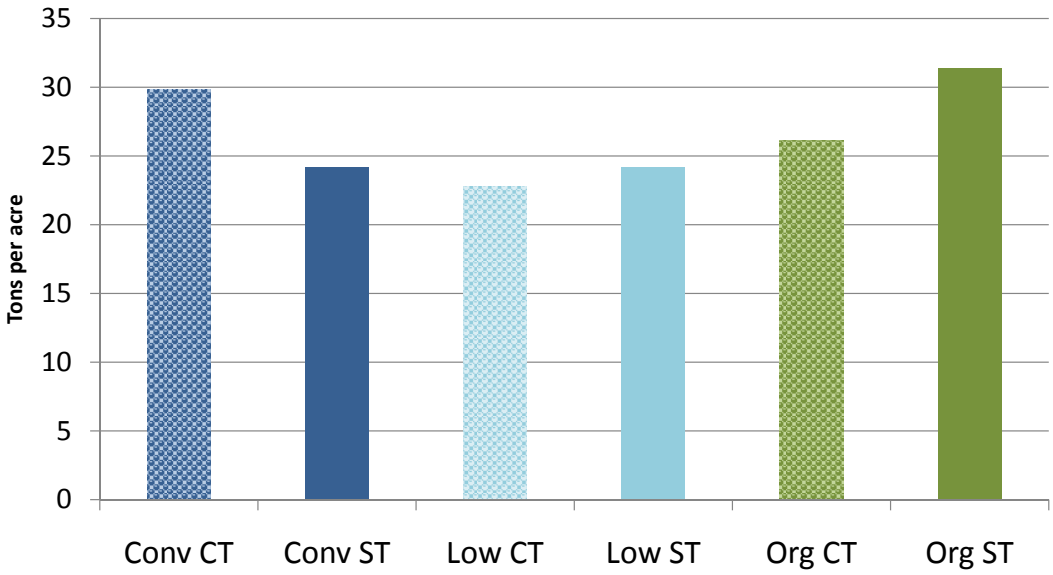
Processing Tomato Harvester

Processing Tomato Harvester

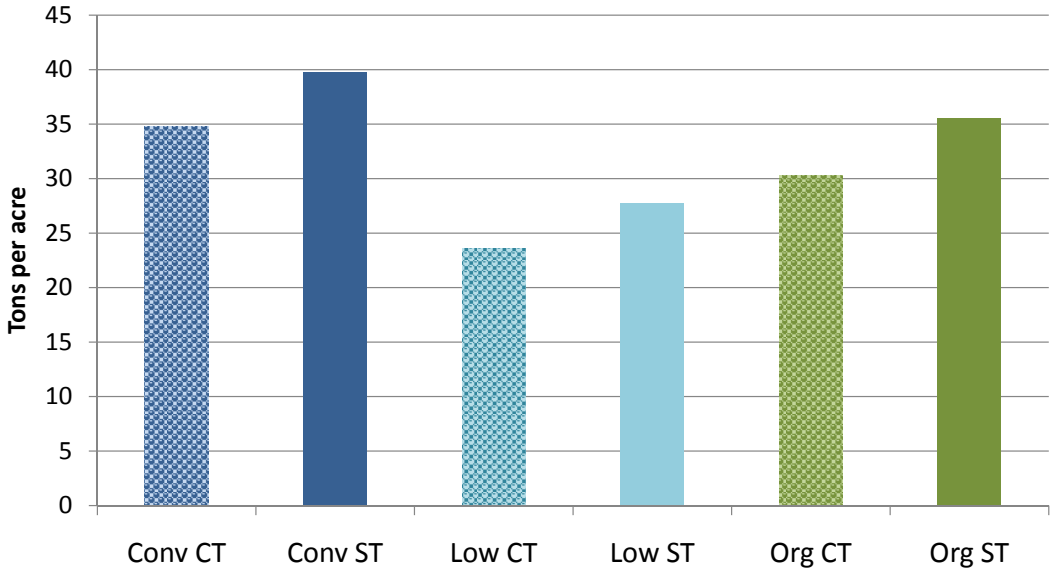
Processing Tomato Harvest

Average Tomato Yields

2003 - 2007

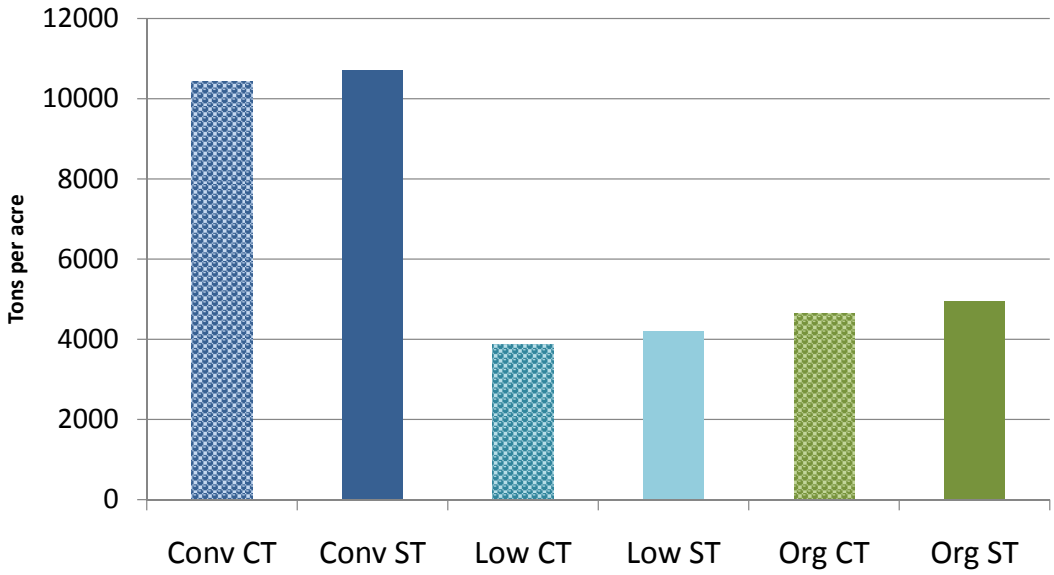


2007 Tomato Yields

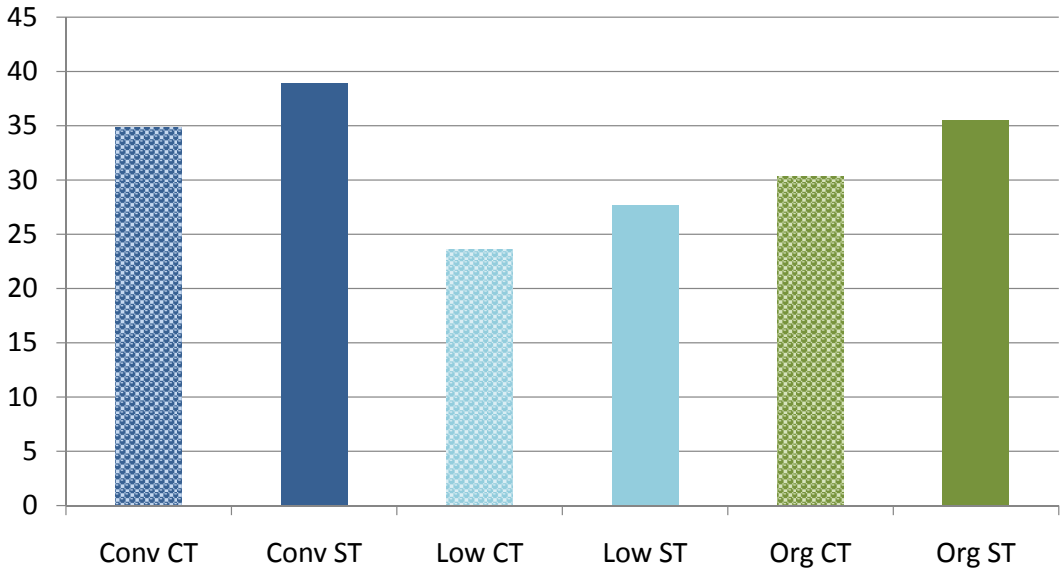


Average Corn Yields

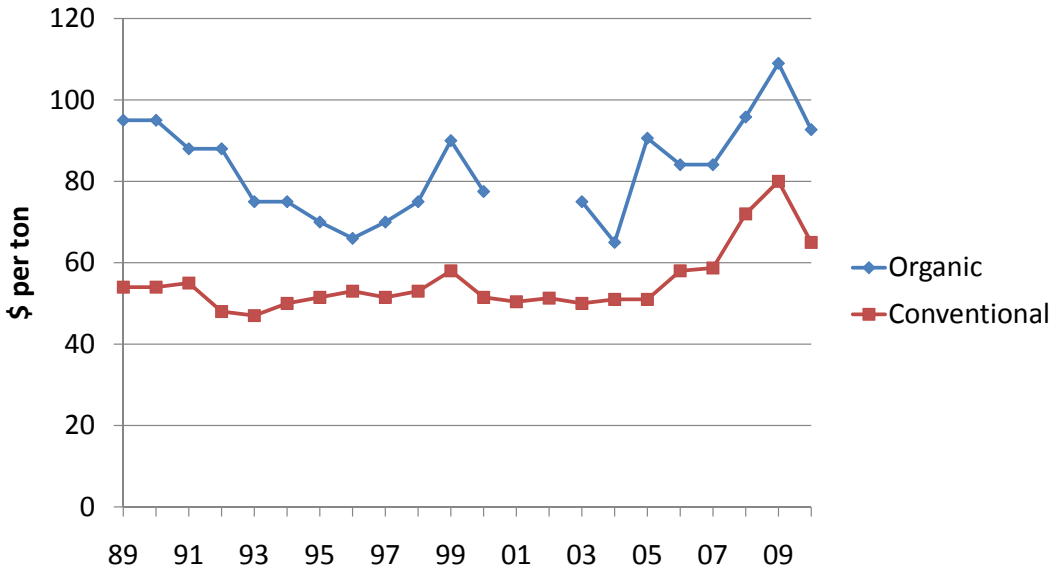
2003 - 2007



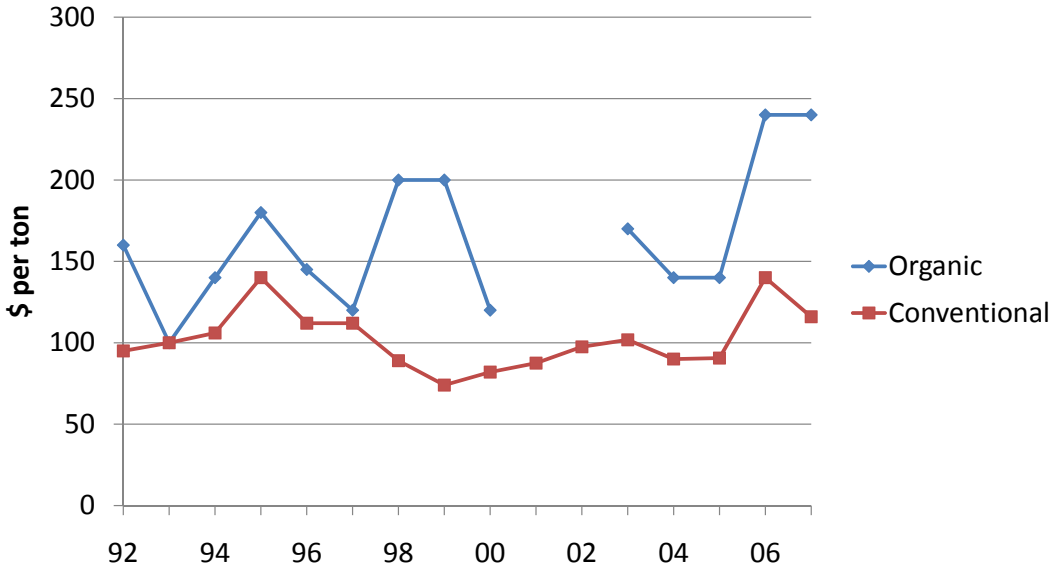
2007 Corn Yields



Organic and Conventional Prices
Processing Tomatoes



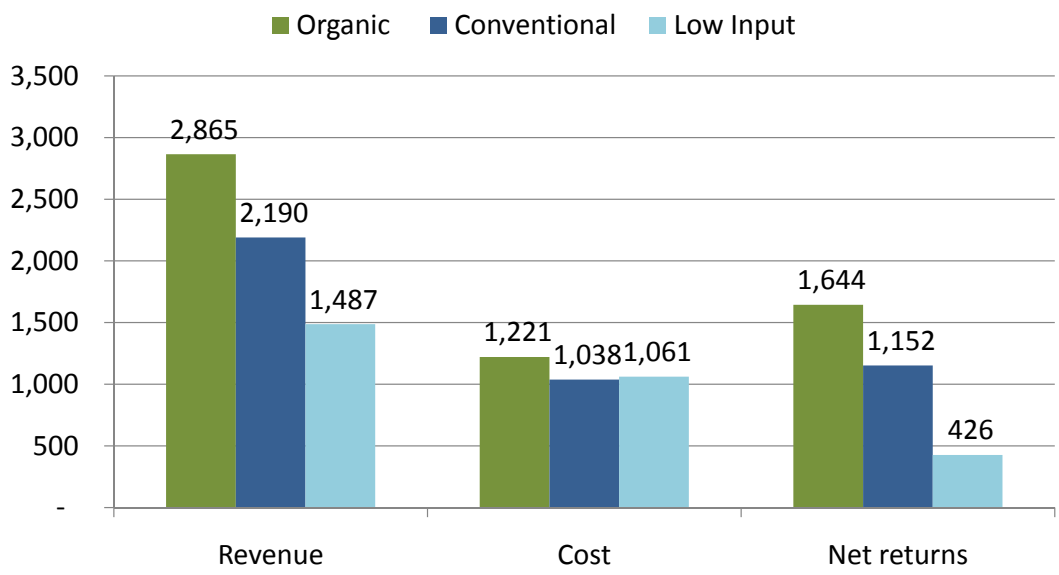
Organic and Conventional Prices
Corn for Grain



2007

NET RETURNS

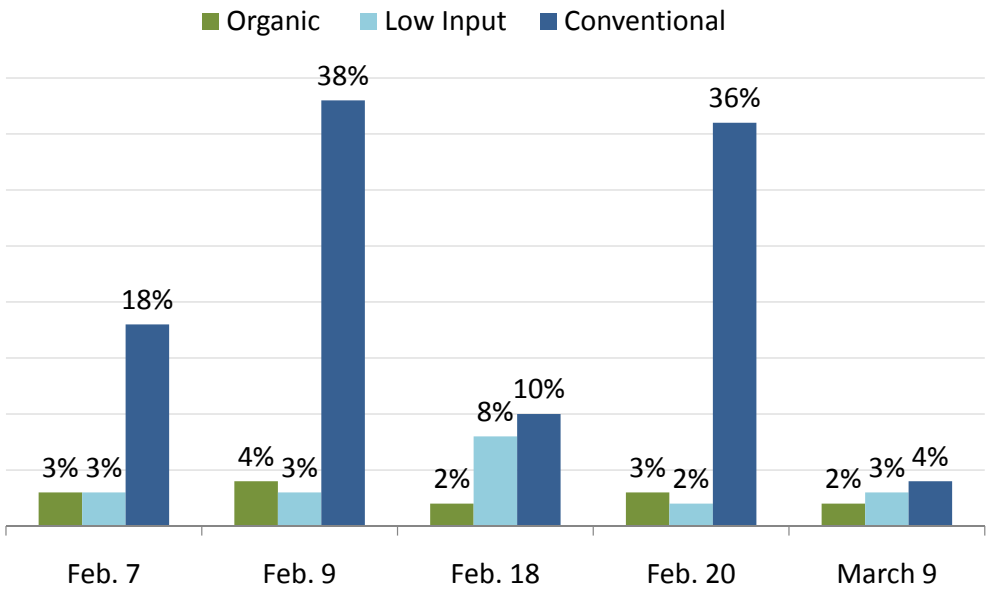
Revenue, Operating Costs, and Net Returns PROCESSING TOMATOES 2007



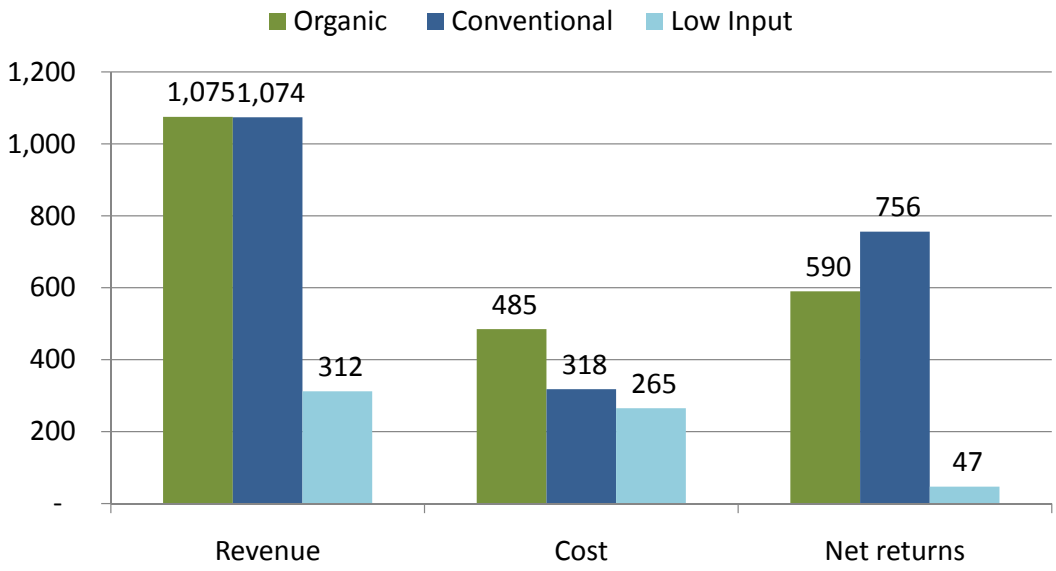
Runoff as a Percentage of Rainfall Events

Cover crop – organic and low input

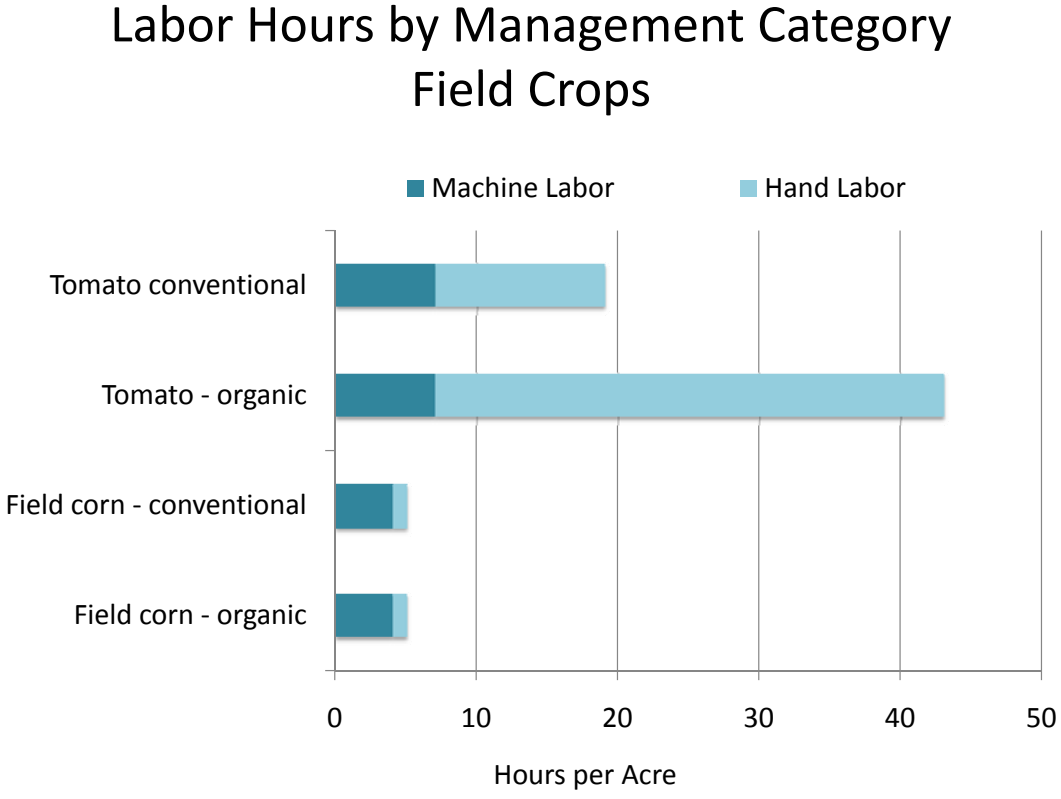
Manure – organic only



Revenue, Operating Costs, and Net Returns CORN 2007



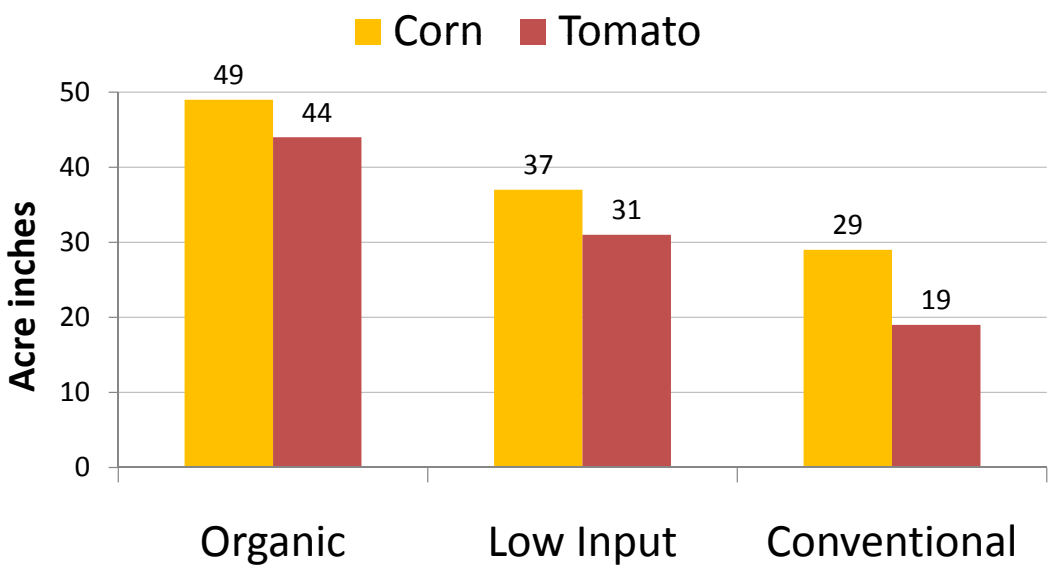
RESOURCE USE



Fuel Use for Cultural Practices

	Fuel (Gallons/Acre)		Times over the Field	
	O	C	O	C
Tomatoes	57	51		
Corn	33	37		

Average Water Use

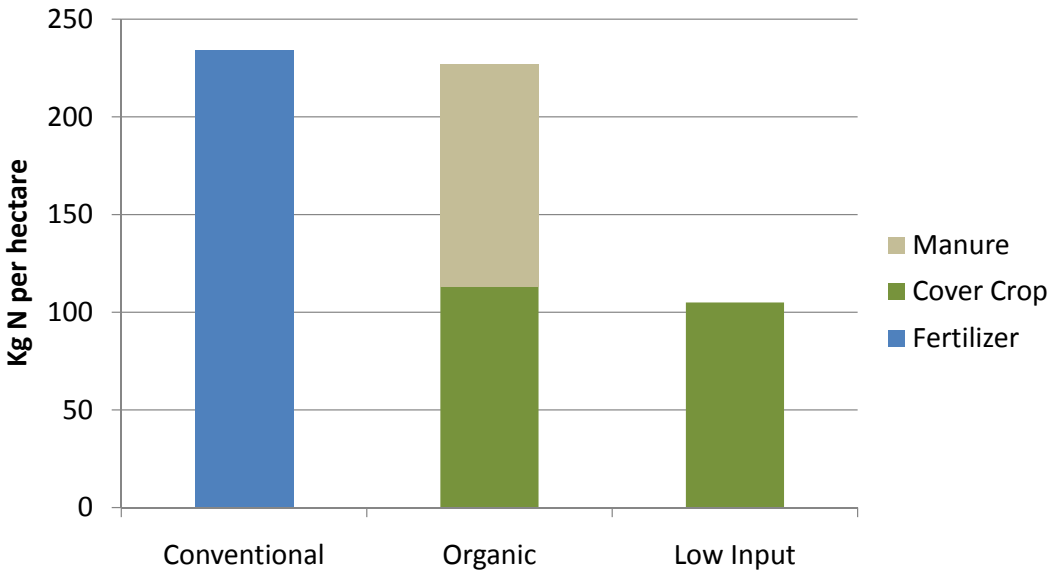


Sources of Nitrogen

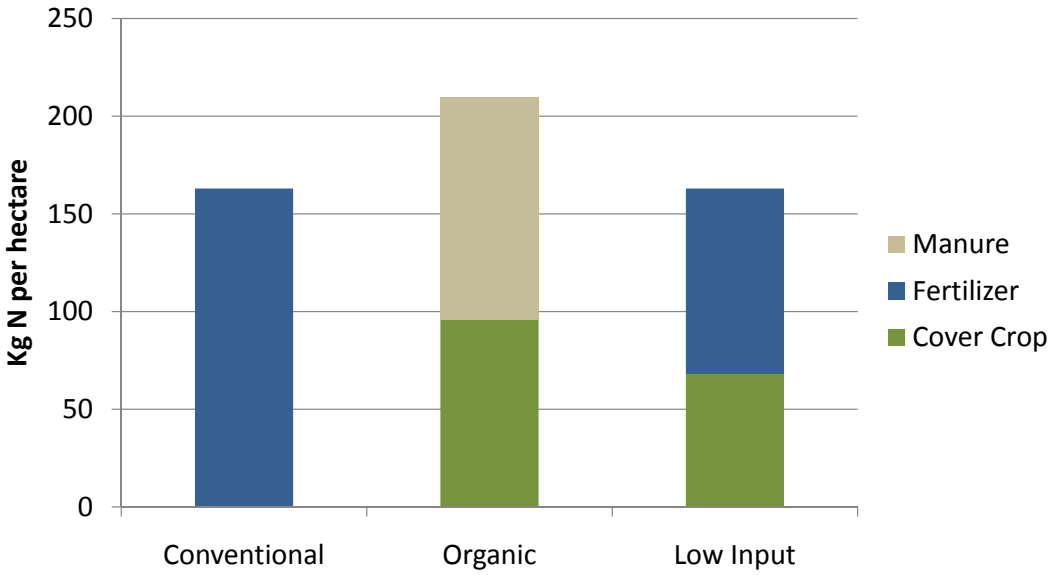
	Organic Tomato	Low Input Tomato	Conventional Tomato
Cover crop	1994 - 2006	2004 – 2006 only	
Chicken manure	Rates reduced after 1997		
Synthetic N	None	1994 – 2003 = conv 2004 – 2006 reduced	15-15-15, ammonium sulfate

	Organic Corn	Low Input Corn	Conventional Corn
Cover crop		1994 - 2006	
Chicken manure	Higher than for tomatoes		
Synthetic N	None	None	Urea

Corn Nitrogen Inputs 02 - 06

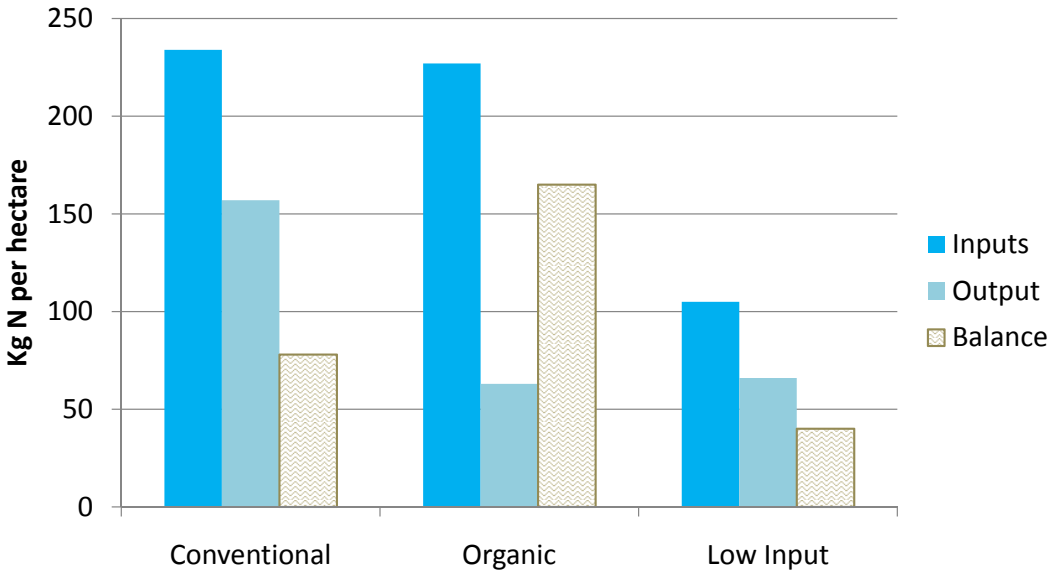


Tomato Nitrogen Inputs 04 - 06

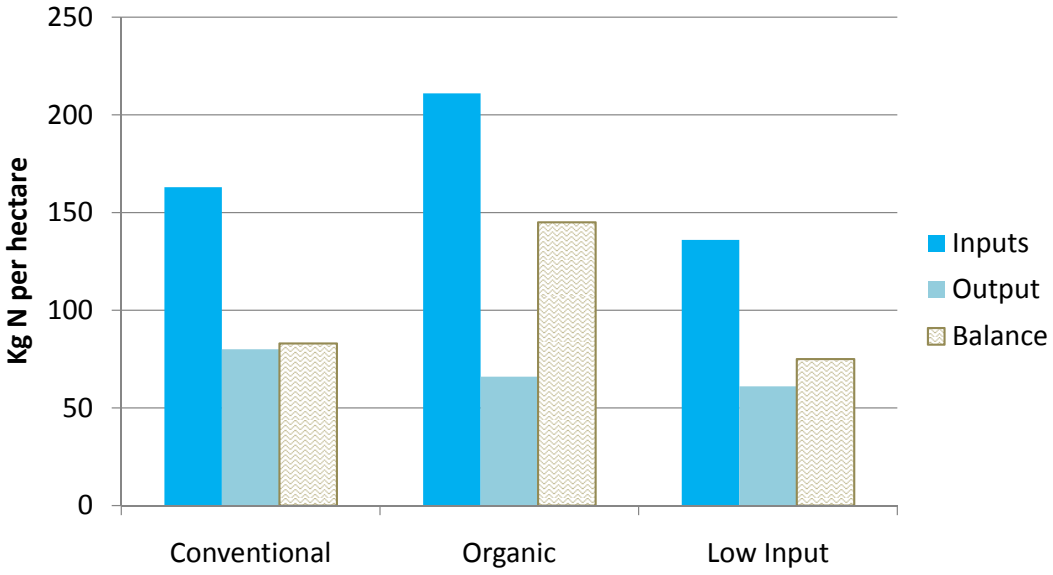


ENVIRONMENTAL IMPACTS

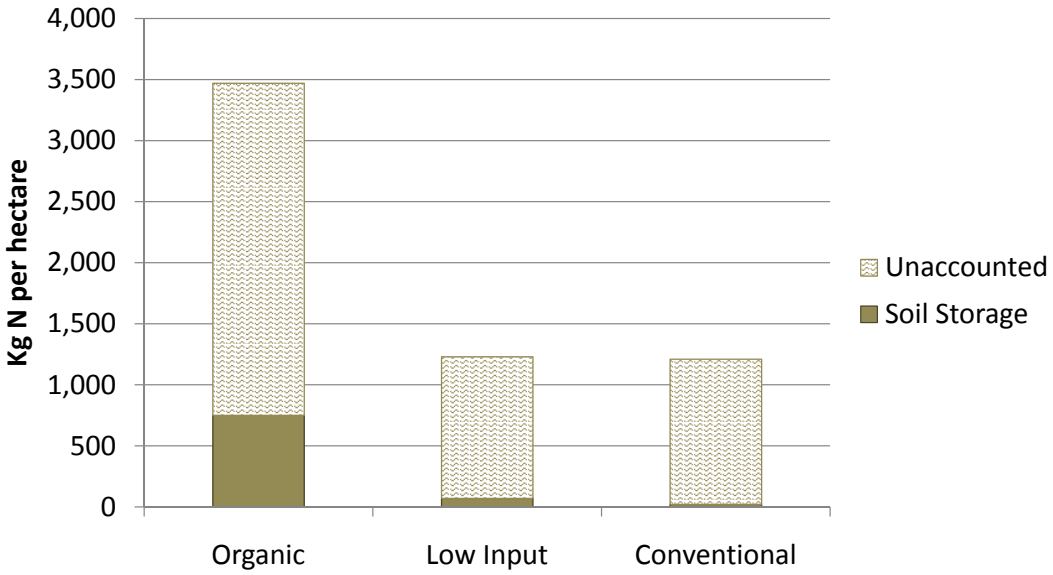
Corn Nitrogen
Inputs, Outputs, Balance



Tomato Nitrogen
Inputs, Outputs, Balance



Nitrogen Balance (Corn and Tomato)
Soil Storage and Unaccounted
Accumulated 1994 - 2006

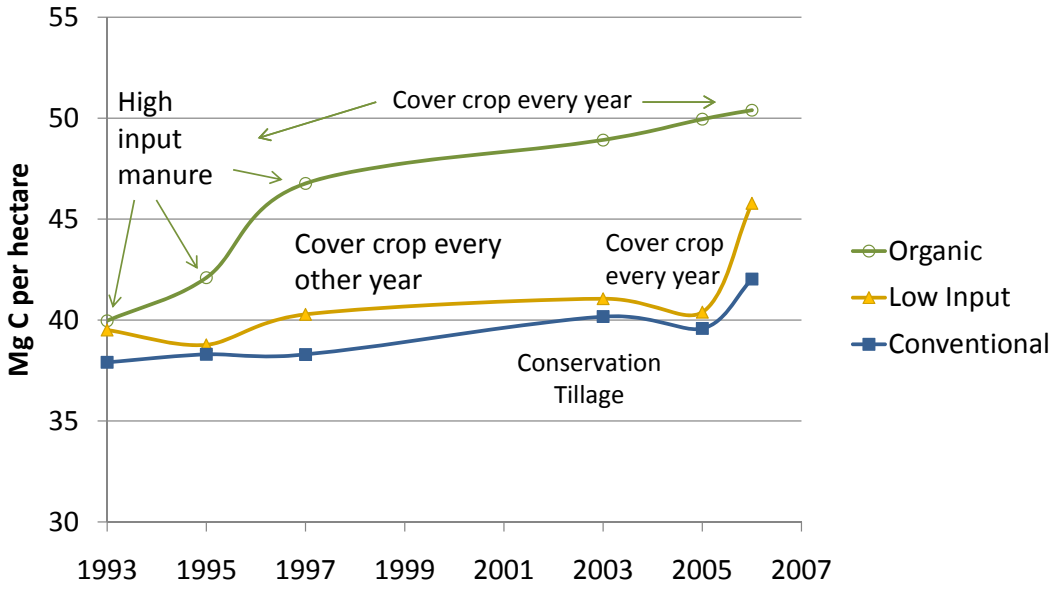


Nitrous Oxide Emissions

Nitrous Oxide Emissions

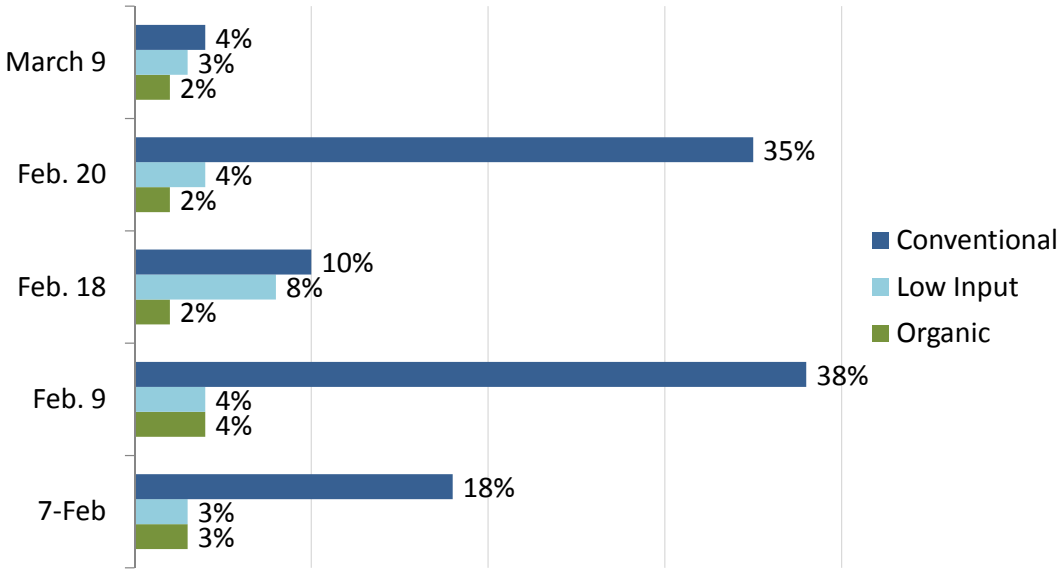
- Emissions were higher with winter legume cover crops for both tillage systems
- This may be the result of adding N to the soil in a form that can be transformed into N_2O under ideal soil moisture and temperature conditions

Soil organic carbon in the top 30 cm



Runoff as a Percentage of Rainfall Events

Standard Tillage - 1999



Runoff Water Quality - 2007

	Conventional		Low Input		Organic	
	Applied	Detected	Applied	Detected	Applied	Detected
Tillam (herbicide)	X	x	X	x	------	------
Trifluralin (pre-emergent herbicide)	X	-----	X	------	------	------
Metolachlor (herbicide)	X	X	X	X	------	------
L-cyhalothrin (pyrethroid insecticide)	X	------	X	------	------	------

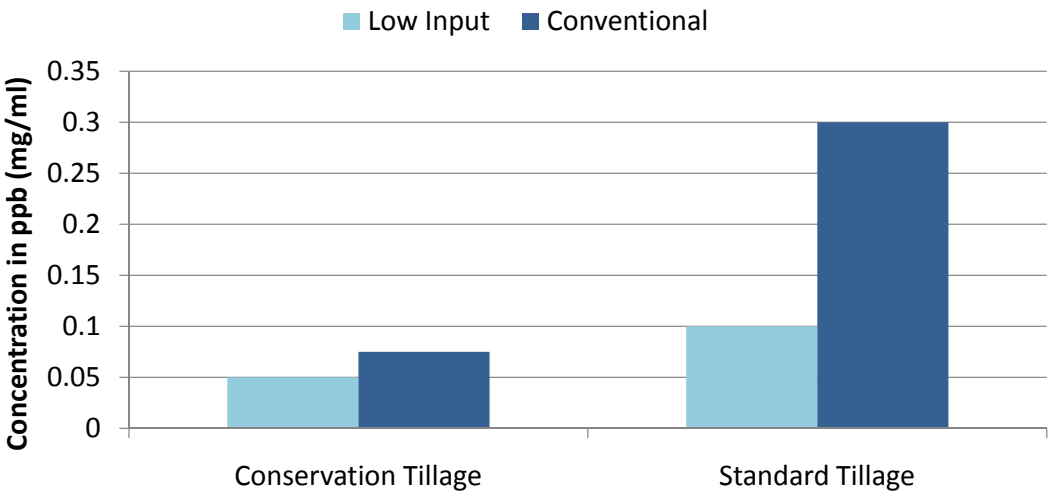
Runoff Water Quality - 2007

Low Input and Conventional Systems

	Standard Tillage	Conservation Tillage
	% of Samples	% of Samples
Tillam (herbicide)	.05%	------
Trifluralin (pre-emergent herbicide)	------	------
Metolachlor (herbicide)	63%	25%
L-cyhalothrin (pyrethroid insecticide)	------	------

Runoff Water Quality - 2007

Pesticide Concentration



Note: No pesticides were found in organic system runoff

Sweeping Generalizations About Organic Agriculture

(at least in California)

- Relies on cover crops, compost, and sometimes liquid fertilizers
- Fertility costs more than for conventional
- Only crops that rely on hand hoeing for weed control use hand hoeing in organic
- When used, labor costs for hand hoeing are higher
- Fewer pest and disease control tools are available
- Some crops are easier to grow organically than others
- Organic price premiums vary from crop to crop but are not trending downward over time

Cover Crop Impacts Not Captured in Cost and Return Analyses

- May delay planting in Spring
- May replace a cash crop in a rotation
- Reduces winter runoff
- Improves the quality of winter runoff
- Increases carbon sequestration
- May increase greenhouse gas emissions
- Provides habitat
- Reduces erosion