



*How Sustainable  
is Organic  
Agriculture ?*

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## Brief History of Organic in America...

Pre-1970s:	Most organic produced/consumed locally.
1970s:	Expansion of market; need for verification.
1970-80s	Creation of "third party certification."
Late 1980s	Many certifiers using different standards.
1990	Organic Foods Production Act -- Mandated creation of the NOP, and uniform organic standards.
April 21, 01	Implementation of regulations began
Oct 21, 02	Complete compliance required



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## The Organic Foods Production Act of 1990

Part of the 1990 Farm Bill, this legislation authorized the establishment of the NOP, the NOSB and the Standards for organic production, processing and trade.

*“It is the purpose of this title...*

- 1) to establish national standards governing the marketing of certain agricultural products as organically produced products;*
- 2) to assure consumers that organically produced products meet a consistent standard; and*
- 3) to facilitate interstate commerce in fresh and processed food that is organically produced.”*



## Organic is NOT...

*Completely chemical-free,*

*A guarantee of chemical-free food,*

*A guarantee of healthier food,*

*A return to the 1800s,*

**Then what IS organic?**



(passed by the NOSB at its April 1995)

## Official NOSB Definition of “Organic”

*"Organic agriculture is an **ecological** production management system that promotes and enhances **biodiversity**, **biological cycles** and **soil biological** activity. It is based on minimal use of off-farm inputs and on management practices that restore, maintain and enhance **ecological** harmony.*

*‘Organic’ is a **labeling term** that denotes products produced under the authority of the Organic Foods Production Act. The principal guidelines for organic production are to use materials and practices that enhance the **ecological** balance of **natural systems** and that integrate the parts of the farming system into an **ecological** whole.*

*Organic agriculture practices cannot ensure that products are completely free of residues; however, methods are used to **minimize pollution from air, soil and water**.*

*Organic food handlers, processors and retailers adhere to standards that maintain the integrity of organic agricultural products. **The primary goal of organic agriculture is to optimize the health and productivity of interdependent communities of soil life, plants, animals and people.**"*



## Factors of Production

Factor	Conventional	Organic
Genetics (seed)	GMOs, treated	Organic source, no GMOs, no treatment
Fertility	Chemically-based, high energy input, hazardous, polluting	Manure, compost, green manures, approved products
Pest management	Chemically-based, high energy input, hazardous	IPM, rotations, ecosystem diversity, approved products
Moisture	Rain, irrigation, down-stream impacts	Rain, irrigation, reduced down-stream impacts
Labor	Minimized by inputs	Heavy requirements
Equipment	Big, expensive	Specialized, to scale



# Organic Principles

## Biodiversity...



**Benefits:** ecosystem (and financial) stability, more beneficial insects, greater below-ground diversity, better nutrient cycling, disease suppression, tilth, and N-fixation.

**Practices:** intercropping, companion planting, establishment of beneficial habitats, crop rotations, cover crops, species/enterprise integration.



# Organic Principles

## Sustainability...



**Benefits:** reduced energy consumption, soil conservation, efficient water use, increased water quality.

**Practices:** conservation structures, conservation tillage, controlled drainage, rotations, mulching, integrated systems.



# Organic Principles

## Natural Plant Nutrition...



**Benefits:** Emphasis on soil health translates into healthier food, healthier humans. Less plant disease, fewer weeds, better water-holding capacity, resistance to erosion.

**Practices:** Crop rotations, cover crops, green manures, animal manures, application of allowable substances in limited quantities, composting.



# Organic Principles

## Natural Pest Management...



**Benefits:** Increased understanding of the whole system, protection of beneficials, don't have to deal with toxic compounds.

**Practices:** Crop rotations, companion plantings, natural predators, ecosystem management, IPM, flame, steam, tillage, composting, cover crops, refuges, *ecosystem balance through management.*



# Organic Principles

## Integrity...



**Benefits:** Protects the concept and value of organic.

**Practices:** Buffers, good recordkeeping



# Claims and Arguments

## **Proponents claim...**

Healthier food

Safer for the environment

More profitable for farmers

## **Critics argue...**

No proof of superior nutrition

Worse for the environment

Not productive enough to feed the world



## Questions?

1. Is organically produced food really healthier?
2. Are organic ag systems productive enough?
3. Is organic really more environmentally friendly?



## Is organic food really healthier?

**2007.** A. E. Mitchell, Yun-Jeong Hong, Eunmi Koh, D. M. Barrett, D. E. Bryant, R. Ford Denison, and S. Kaffka. **Ten-Year Comparison of the Influence of Organic and Conventional Crop Management Practices on the Content of Flavonoids in Tomatoes.** J. of Agric. and Food Chem. American Chemical Soc.

Secondary plant metabolites such as the flavonoids are good for human health...

Protect against cardiovascular disease,

Protect against cancer and other age-related diseases such as dementia,

Demonstrate potent in vitro antioxidant activity and display free radical scavenging activity.



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Secondary plant metabolites such as the flavonoids also...

Activated by environmental stresses including nutrient deficiency, wounding, pathogens, and UV radiation.

Function in plant defense mechanisms against herbivory, pathogen stress, and UV radiation,

Are the primary pigments responsible for attracting pollinators and seed dispersers,



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More background:

Organic and conventional systems differ in many ways, like source of N

Increased crop growth and development rates and greater biomass accumulation in well-fertilized crops would also correlate with decreased allocation of resources toward the production of starch, cellulose, and non-nitrogen-containing secondary metabolites.



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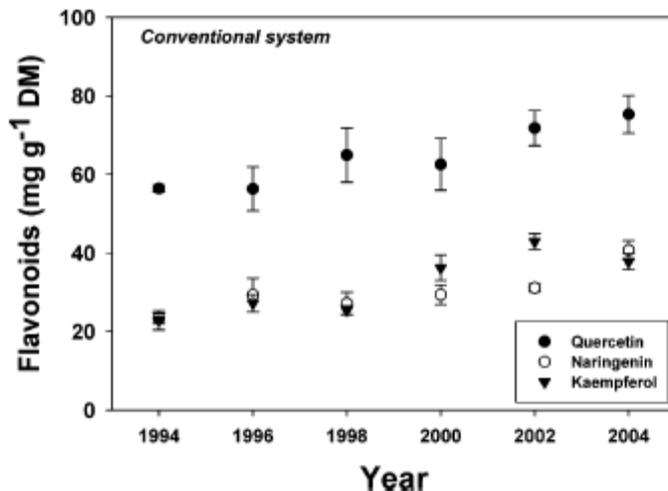


Figure 2. Quercetin (●), naringenin (○), and kaempferol (▼) levels in tomatoes derived from conventional cropping systems at LTRAS from 1994 to 2004 (mg g<sup>-1</sup> of DM). Values are given with standard deviations.

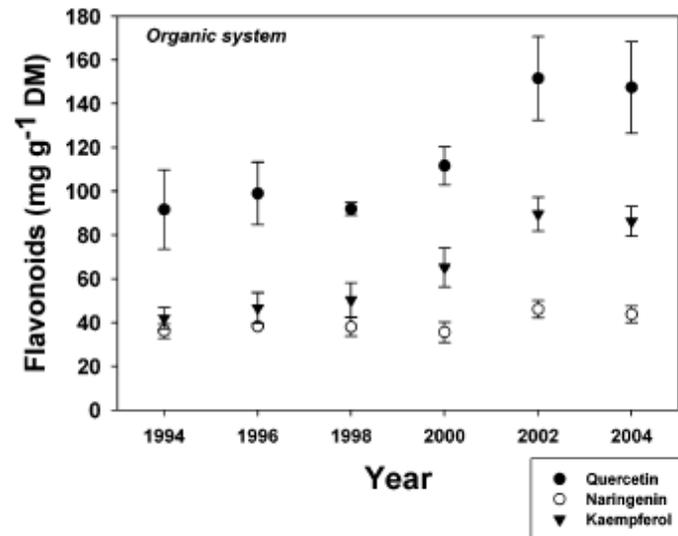


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Table 1. Mean Flavonoid Concentrations in Archived Samples from the LTRAS Experiment (1994–2004) and Single Degree of Freedom Contrasts between Conventional and Organic Farming Systems

flavonoid	mean (SD) (mg g <sup>-1</sup> of DM)		<i>F</i>	<i>p</i>
	conventional	organic		
quercetin	64.6 (2.49)	115.5 (8.0)	108.16	<0.0001
naringenin	30.2 (1.57)	39.6 (1.58)	66.36	<0.0001
kampferol	32.06 (1.94)	63.3 (5.21)	96.64	<0.0001



# Is organic productive enough?

**2001.** Bill Liebhardt. **Get the facts straight: organic agriculture yields are good.** OFRF Information Bulletin, Summer 2001, #10.

Reviewed replicated research results from seven major state universities:

**Corn:** 69 total cropping seasons compared, organic yields were 94% of conventionally produced corn.

**Soybeans:** Data from five states with 55 growing seasons of data, organic yields were 94% of conventional yields.

**Wheat:** Two institutions with 16 cropping year experiments, organic wheat produced 97% of the conventional yields.

**Tomatoes:** At the University of California, 14 years of comparative research on tomatoes showed no yield differences between conventionally and organically grown crops



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In 1989, a large-scale, long-term study entitled the Wisconsin Integrated Cropping Systems Trials (WICST) was initiated at two locations in southern Wisconsin to compare the productivity, profitability, and environmental impact of a range of grain and forage-based cropping systems.

**Corn:** Compared across years and systems, organic corn yields were 91% of conventional corn yields.

**Soybean:** Compared across years and systems, organic soybean yields were 92% percent of conventionally grown beans.

**Forage dry matter:** Organic system yielded 10% more than conventional.



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Conclusions:

Crop rotation and manure seemed to be the determining factor.

Combining years masked the impact of weeds...

In roughly 34% of the site-years, weed control was such a problem, mostly due to wet weather, that the relative yields of the organic systems were approximately 74% of conventional systems.

In the other 66% of the cases, where mechanical weed control was successful, the yield of the organic crops was 99% of conventional systems.



## Is organic environmentally friendly?

**2007.** Ziesemer, Jodi. **Energy Use in Organic Food Systems.** Natural Resources Management and Environment Department Food and Agriculture Organization of the United Nations.

The US food system accounts for 19% of the national fossil fuel energy use (Pimentel, 2006).

Conventional agriculture uses more overall energy than organic systems due to heavy reliance on energy intensive fertilizers, chemicals, and concentrated feed.

Organic agriculture often performs relatively better in terms of energy efficiency (measured as the ratio of energy input per unit of crop output) despite lower yields.

With lower energy inputs, organic systems contribute less to greenhouse gas emissions and have a greater potential to sequester carbon in biomass than conventional systems.



# Is organic food really healthier?

**Answer: Yes**

Organic agroecosystems seem to promote the production of higher levels of secondary plant metabolites such as the flavonoids.

Lower levels of pesticide residues found on organic food.



# Is organic productive enough?

**Answer: Yes**

Tests that compare systems show organic performing 90+% as well as conventional

Research funding for organic is less than 1%. What Could be done if a real research effort was applied?



# Is organic environmentally friendly?

**Answer: Yes**

Soil OM increased

Carbon sequestered

Water quality improved

Biodiversity preserved

Energy conserved