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Sustainable Horticulture in Fruit Production

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Outline

- What is sustainable agriculture? (definition, strategies)
- Sustainability issues in fruit production
- Has fruit production become more sustainable? (IFP, organic, comparisons)
- Future sustainability


Organic blueberries

Sustainable Agriculture

"A long-term goal"

Economically Viable

Environmentally Sound

Socially Acceptable

A 3-legged stool

Not a set of farming practices

Meet the needs of today without compromising the ability of future generations to meet their needs

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Three Major Strategies for Sustainability

- **Efficiency**
  (water, spray, nutrients)
- **Substitution**
  (IGRs, microbials for organophosphates)
- **Redesign**
  (perennial polyculture)

(McRae et al., 1990)

Redesigning Farming

Albert Smith farm, southeast Minnesota

Redesigning Agroecosystems

'Pedestrian' orchard benefits:

- economic (faster returns, higher quality fruit, lower labor costs for maintenance)
- environmental (better IPM)
- social (less ladders, less worker injury)

Trade-off: more sunburn ?

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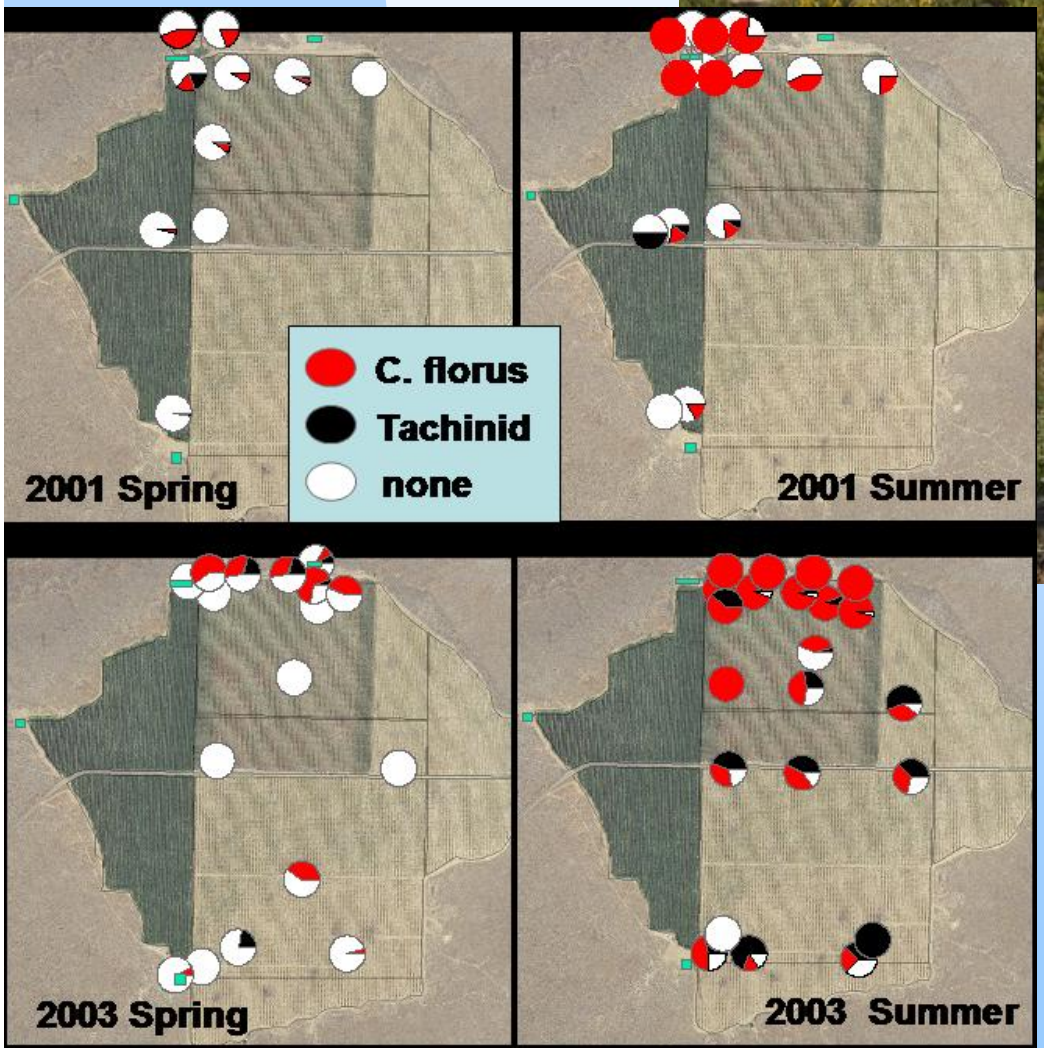
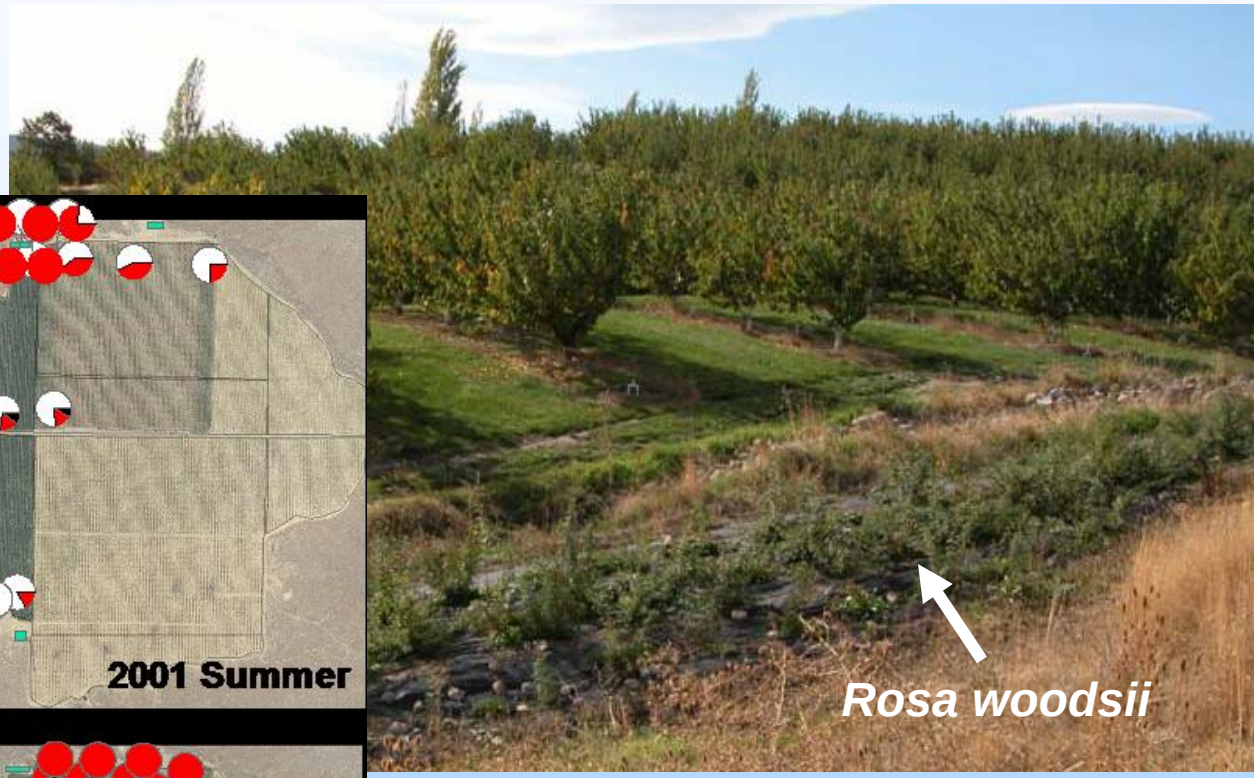
Redesign with Rose Gardens





Rose gardens planted in 2000; parasitism increases thru the summer and has increased from 2001-2005

Courtesy: T. Unruh

How do we measure sustainability in agriculture?

System comparison studies

- long term studies
- do they use the latest technology?

Established standards

- soil erosion (tolerable soil loss)
- water quality (10 mg/L nitrate)
- pesticide residues, worker exposure

Indices – soil quality, Env. Impact Quotient

Economics – profitability, new farmers

Social – family farms, community impacts, food quality and human health

No single unifying measure

Global Sustainable Ag Trends

Production

IPM / Biocontrol of pests

Organic farming

Water quality protection (pesticides, nutrients, pathogens)

Biodiversity enhancement on farms

Marketing

More product identity – ecolabels, wine grape sustainability code, fair trade, country of origin

Social accountability in business - SASA; sustainable business practices

Sustainability Issues in Fruit Production

- Economic -

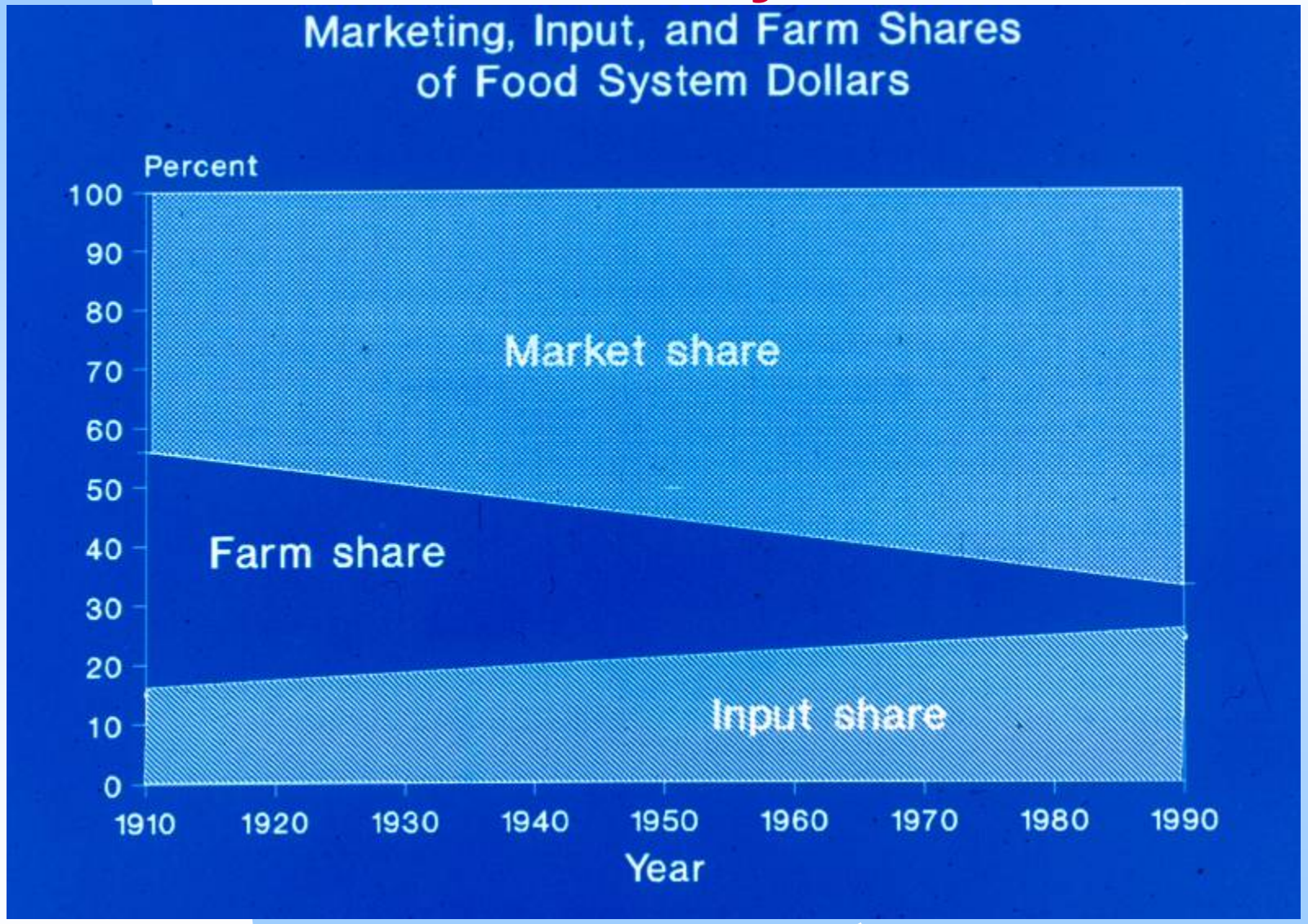
WSU study – high density Fuji apple, 40 ha farm

Variable costs	$7350 / ha
Fixed costs	$6867 / ha
Labor	$ 3.12 / box
Total growing + harvest	$10.28 / box
Warehouse costs	$ 7.50/ box
Breakeven	$17.78 / box
Ave. price 2000	$12.75 / box
Loss	$6916 / ha

1995-2002 – price > breakeven in 4 of 8 years

(Schotzko, 2004)

Sustainability Issues



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(S. Smith)

Sustainability Issues in Fruit Production

- Environmental -

Pesticides

Water quality, quantity

Energy

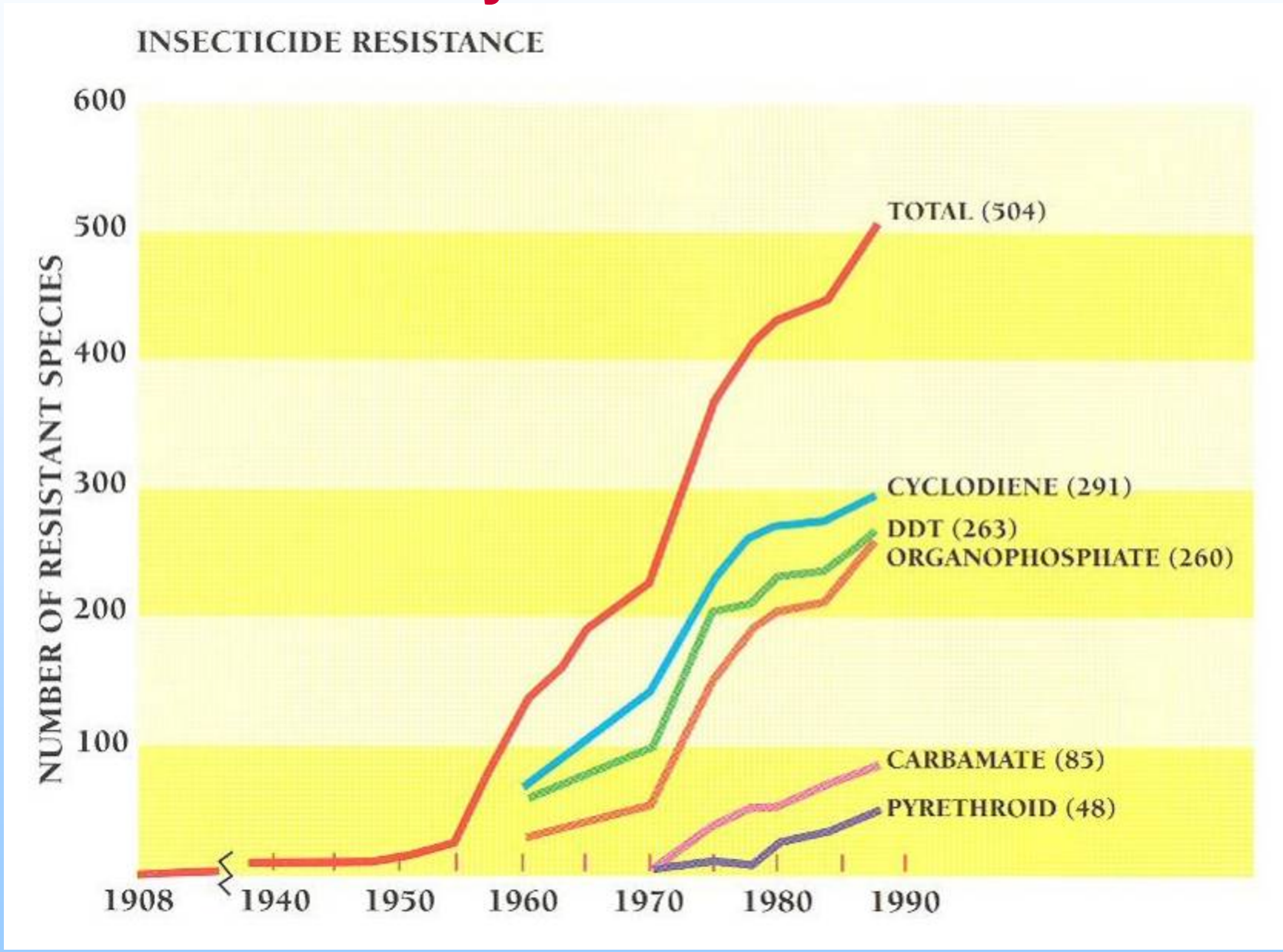
Atmosphere (e.g. methyl bromide)

Biodiversity, habitat

Loss of farmland, urbanization

Degraded water quality

Sustainability Issues - Environmental



(Source: US EPA)

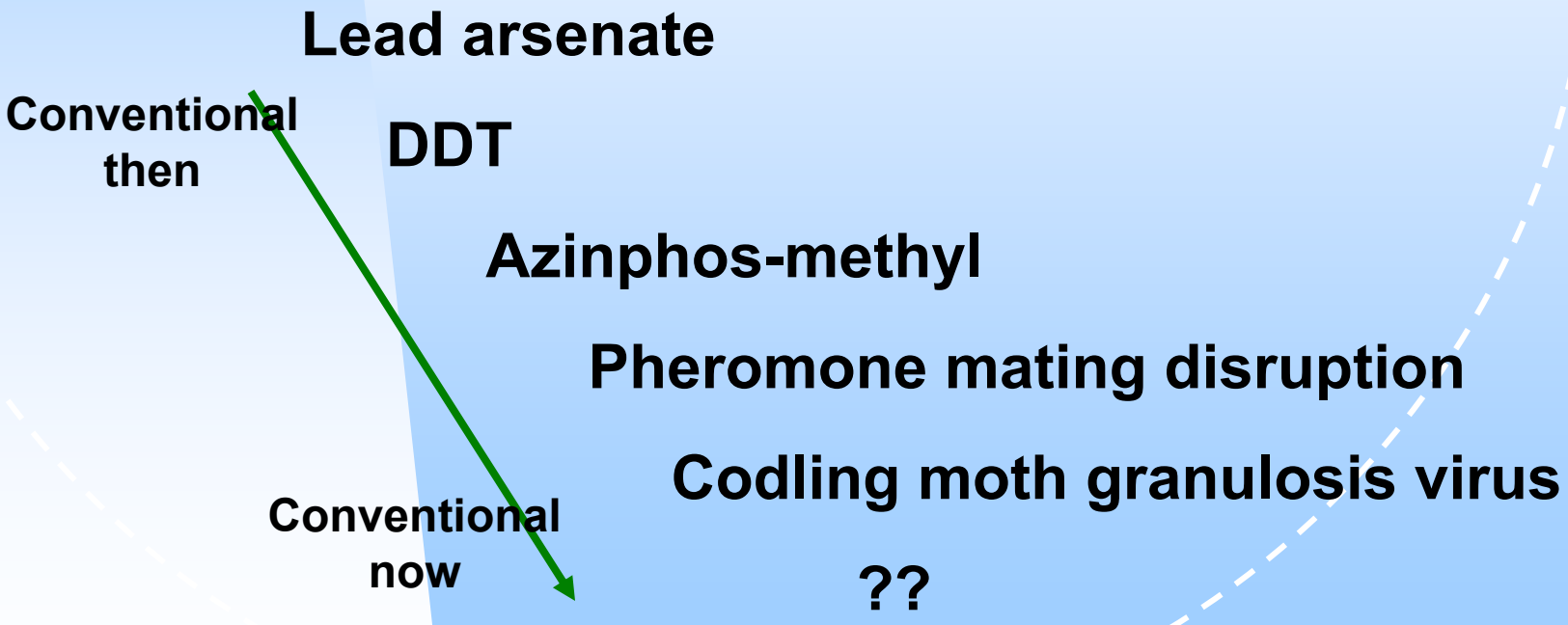
Social Sustainability

- Family farms
- Rural communities
- Food security
- Next generation of farmers
- Farm workers
- Human health
- Fair trade

Has fruit production become more sustainable?

Pest management successes – IPM, biocontrol, reduced risk products

Apple - *Cydia pomonella* control – change over time



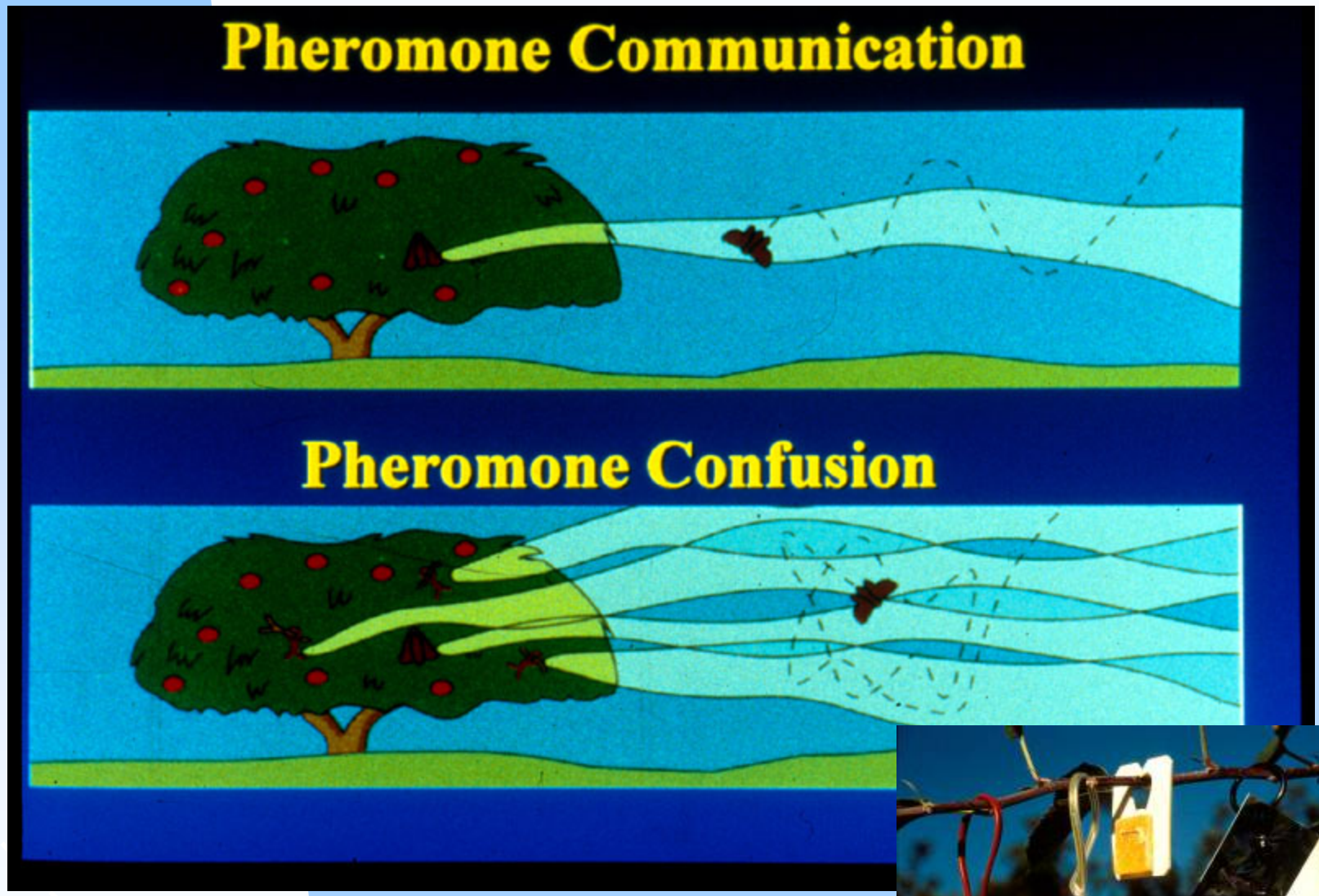
Has fruit production become more sustainable?

IPM and Biocontrol in Washington Apples

	Total kg a.i./yr	
Pesticide	**1989**	**2000**
Guthion	193,270	117,680
Dimethoate	5,410	60
Malathion	28,820	1,730
B.t.	370	11,090
Spinosad	n.a.	3,000

	% growers using	
Practice		
Field monitor	91	99
Econ. threshold	37	92
Use biocontrols	34	81

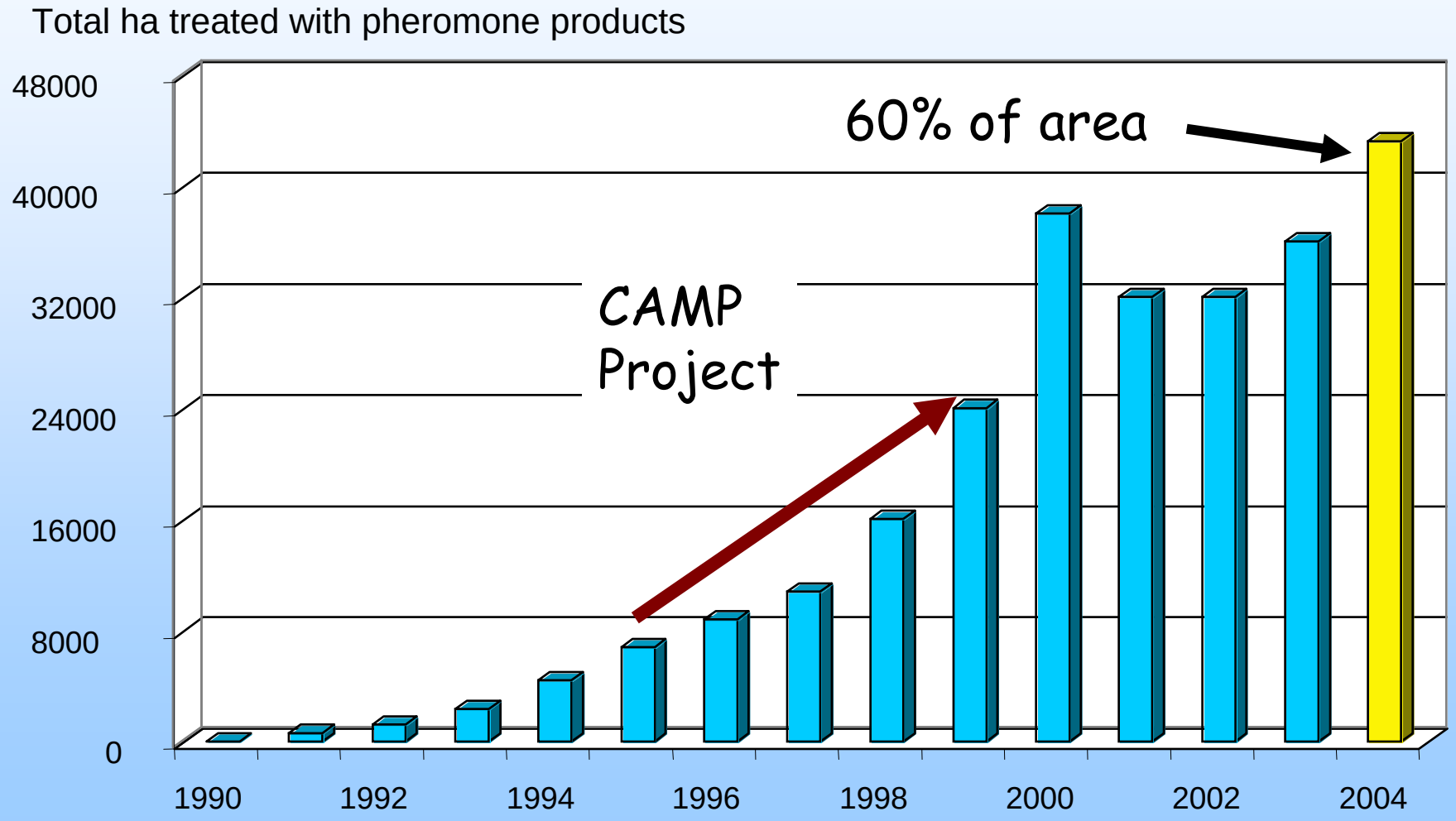
Source: WSU IPM survey



Mating Disruption in Apples

Pheromone dispensers

Codling moth pheromone products uses in Washington apple and pear orchards



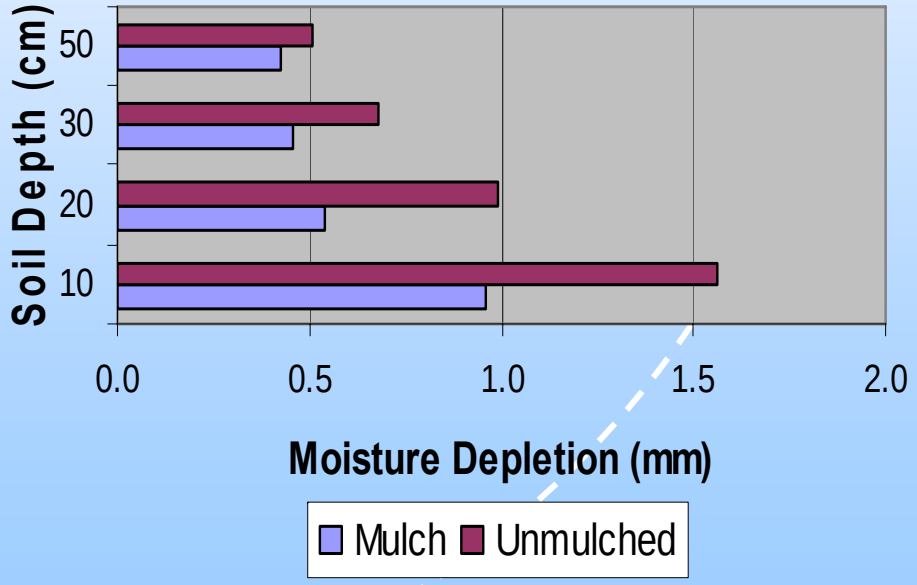
Source: J. Brunner

Has fruit production become more sustainable?

Water conservation – micro sprinklers, drip irrigation, soil moisture monitoring, deficit irrigation

Evaporative cooling ?

Effect of Orchard Mulching on Soil Moisture Depletion



Has fruit production become more sustainable?

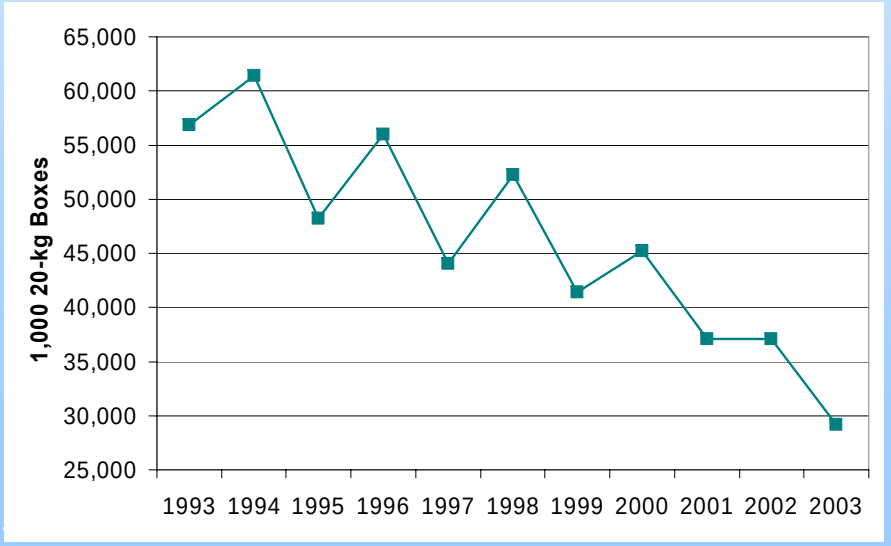
US per capita fresh fruit consumption 1970-2004:

Apple – no change	Banana +48%
Orange -33%	Grape +177%
Total +24%	

Greater emphasis on fruit and vegetable consumption – 'Five A Day' campaign

Growth in pre-sliced fruit – meets the convenience factor, healthy snack food

New fruit varieties, more focus on flavor



Decline in 'Red Delicious' production – Washington State

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Has fruit production become more sustainable?

Two established approaches:

Integrated Fruit Production (IFP)

Organic farming

Similarities:

- Emphasize bio-intensive management, whole system
- Use guidelines, standards, certification, label identity
- Restrict materials

Differences:

- IFP focus on IPM, organic focus on soil
- Synthetics generally not allowed in organic, fewer tools
- Organic standards more rigid, less adaptable to locale
- Organic more widely known by consumers, higher price
- No GMOs in organic

Integrated Fruit Production (IFP)

Framework, guidelines and principles developed by IOBC (1993)

- **Crops**
- **Nutrient management**
- **Soils**
- **Biological diversity and landscape**
- **Pest control**
- **Product quality**

Strong emphasis on Integrated Pest Management (IPM) and biocontrol

Many regional, national programs for pome fruit, stone fruit, grapes

Integrated Fruit Production (IFP) Experience

- Driven by Europe (40% of apple and pear acreage in IFP, 1994), markets demanded IFP fruit
- Exporters to Europe developed IFP programs (NZ, S. Africa, Argentina)
- Europe has good infrastructure for IFP
- IFP has helped reduce production costs
- No price premium to growers; government subsidies are key

'Sandwich' system

Integrated Production in the US

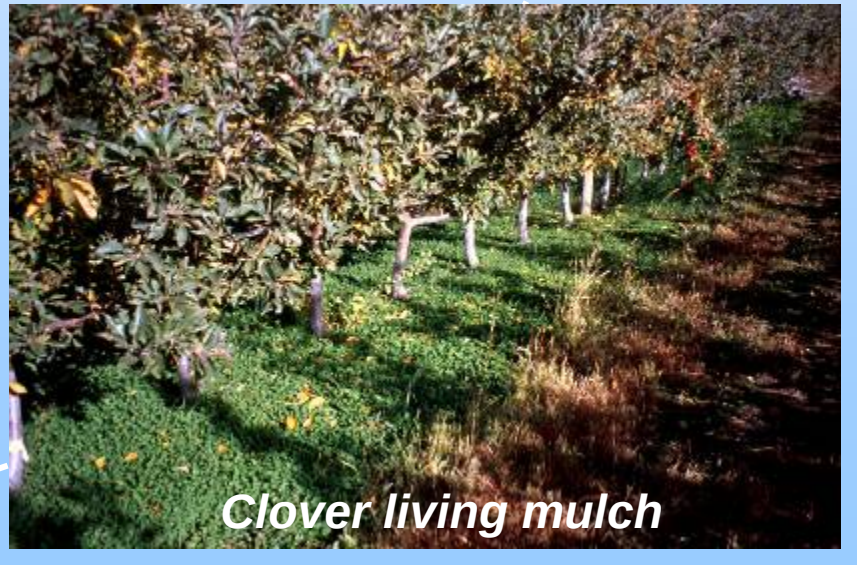
- Confusion, competition with “organic”
- Provides a positive message about agriculture
- Some price premiums in other foods (beef, vegetables)
- Some success with market access for fruit (Food Alliance, Salmon Safe)
- Increased interest in wine grapes
- Infrastructure not developed

Impacts of IFP

- Pesticide reduction (50%, New Zealand)
- Resistance management, more biocontrol (apples, Italy)
- Water conservation (50%, USA)
- Improved yield (+26-45%, Canada)
- Reduced costs (bananas, Costa Rica)

Organic Agriculture

- Accounts for ~2% of food sales, <0.01% of ag land in US
- Over 10% of ag land is organic in some European countries, >5% of food sales
- Organic food sales growing at 20% per year
- Legally binding certification systems worldwide
- Strong consumer recognition, unclear understanding
- Focus on soil health, natural materials
- Fewer tools, often less durable or effective


Clover living mulch

Organic Fruit Production

Sensitive to agroclimatic conditions; often less pest and disease problems in semi-arid regions

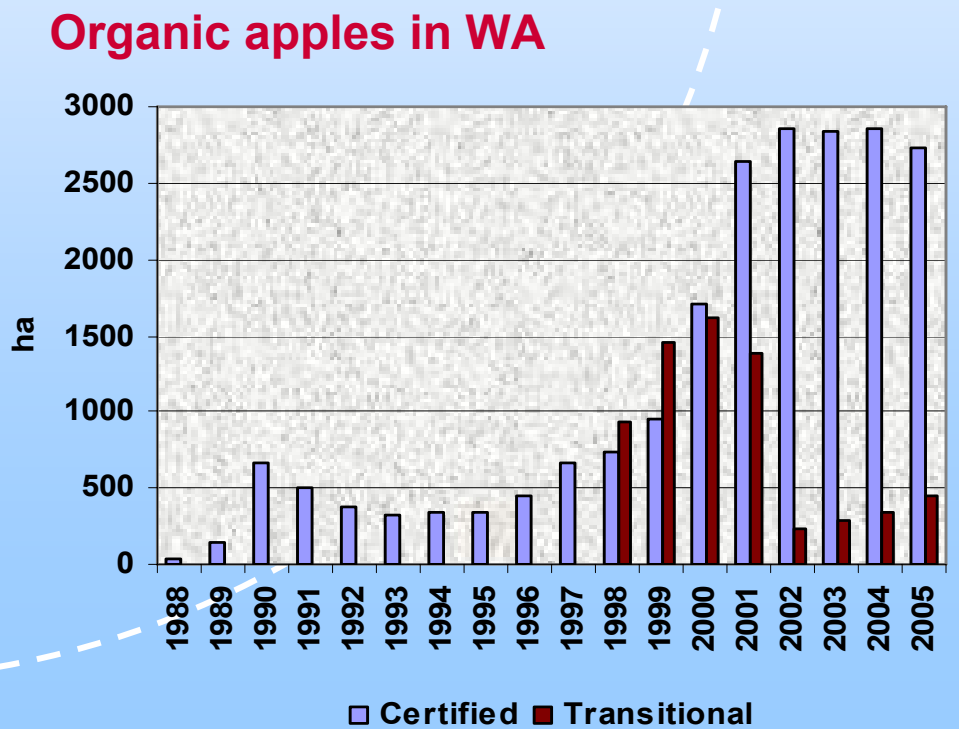
Higher cost: fertility, pest control, labor

Yields, quality – similar to conventional in Washington; up to 50% reductions in more humid regions

IPM, biocontrol progress benefits organic

Need price premium; but often more profitable

Requires higher level of management



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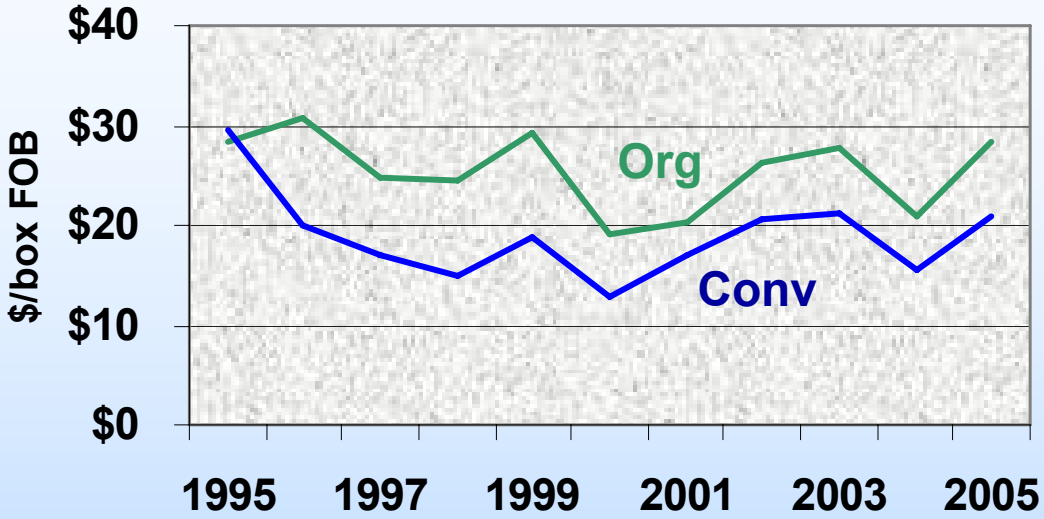
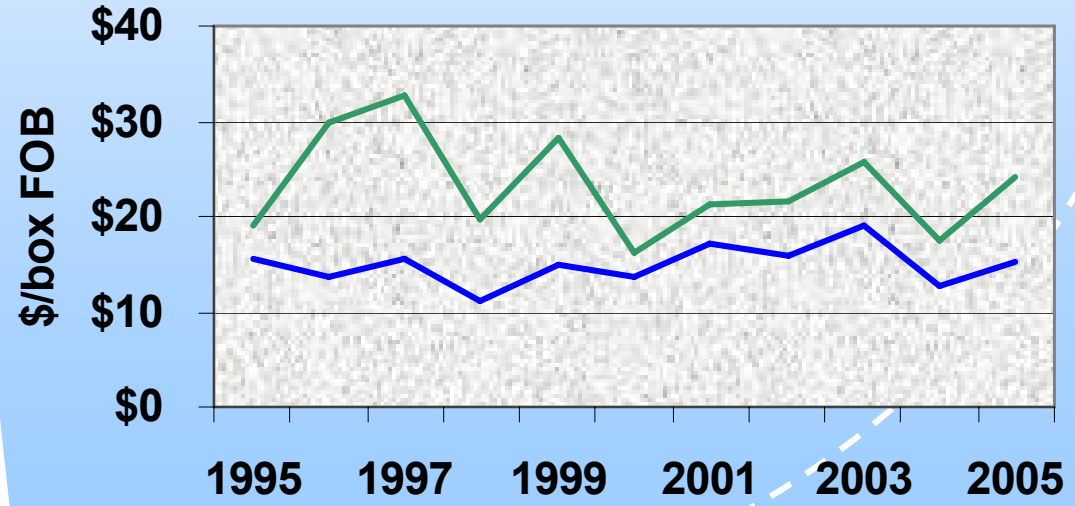
Apple Price Trends – Washington State, USA

Fuji



Golden Delicious



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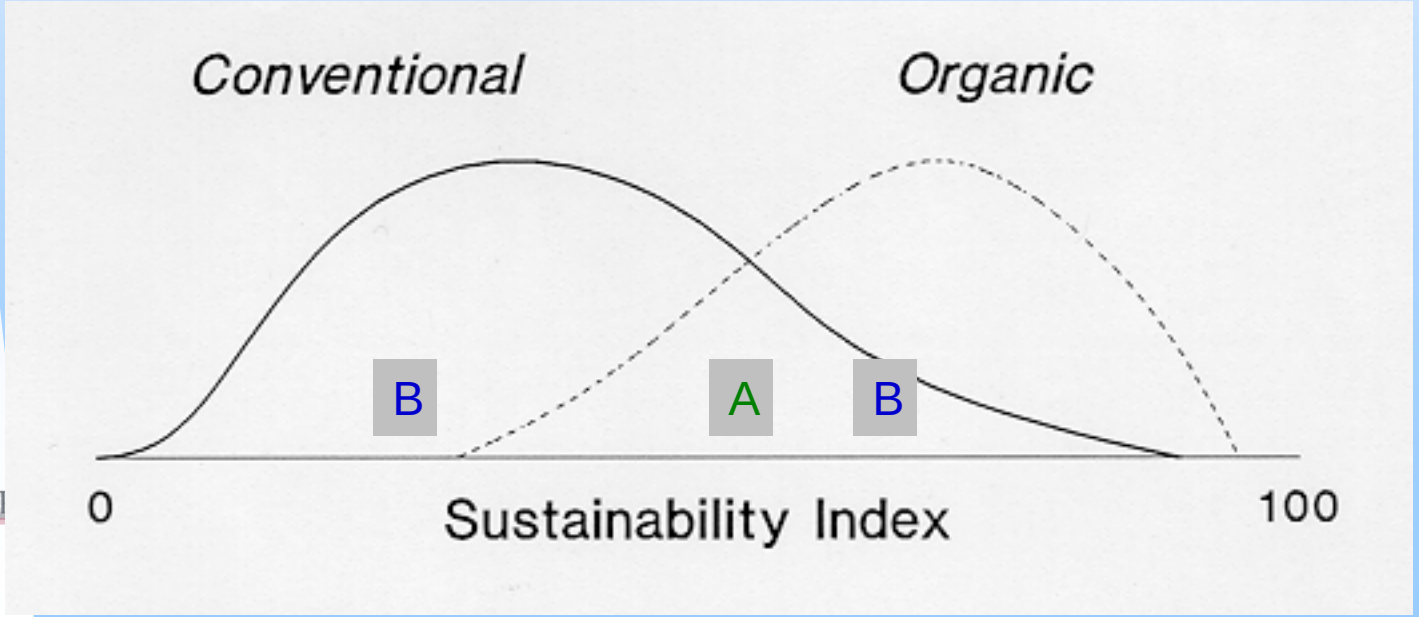
WA Growers Clearinghouse data

Organic and Sustainability

- Organic farms vary in their sustainability, as do conventional
- Organic farm A might be more or less than conventional farm B
- Organic farms are more likely to be more sustainable than conventional

Hypothetical distribution of farms on a sustainability index



The European Experience

Indicators	++	+	0	-	- -
Ecosystem			X		
Soil (erosion, OM)			X		
Ground and Surface Water (leaching)		X			
Climate and Air			X		
Farm Input and Output (nutrient, water, energy use)		X			
Animal Welfare and Health			X		
Quality of Produced Food			X		

Legend: ORG compared to CONV: ++ much better, + better, 0 same, - worse, -- much worse

Stolze et al, 2000: The Environmental Impacts of Farming in Europe

Nitrate Leaching Rates - Europe

Reduction in nitrate leaching from organic farms compared to conventional	Authors
>50%	Smilde (1989)
>50%	Vereijken (1990)
57%	Paffrath (1993)
40% (sand) 0% (loam)	Blume et al. (1993)
50%	Reitmayr (1995)
40%	Berg et al. (1997)
64%	Haas (1997)

(Scialabba and Hattam, 2002)

Sustainable Ag Trial – California

Conv. 2 yr, Conv. 4 yr, low input, organic – 12 year study

Yield difference never more than 10%

Cover crop – increased summer infiltration 2x, decreased winter runoff >10x

Conv. Lost 10x more applied N than low input, 5x more than organic

	N input (kg/ha)	Loss of applied N (%)
Org	1924	4.6
Low	1550	2.4
Conv 4	1827	22.3
Conv 2	1584	28.5

(Huyck et al., 2003)

Effect of apple orchard management system on sustainability indicators

WSU Orchard Systems Trial - Washington, USA

	Conv.	Integrated	Organic
Total energy input (MJ/ha)	516,489	488,661	445,328
Environmental impact rating	2,893	2,211	466
Soil quality rating	0.70	0.81	0.83
TCSA 6th leaf (cm^2)	28.0	28.2	28.5
Fruit yield 1996-99 (MT/ha)	210	205	198
Variable costs ($/ha/yr)	10,145	9,666	9,124

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(Reganold et al., 2001)

Organic Orchards in the Northeast USA

Pest Management Costs IFP vs. Organic Apples - 2004

Cost category	IFP (US$/ha)	Organic (US$/ha)
Spray products	$961	$2,198
Spray labor	$768	$889
Hand thinning	$684	$929
Cultivating		$57
Fruit washing		$1,754
Totals for year:	**$2,413**	**$5,827**

(Merwin et al., 2005)

Environmental Impact Quotient
-- Red Delicious apple, New York State, USA

Conventional	IPM	Organic
938	167	1799

(Kovach et al., 1992)

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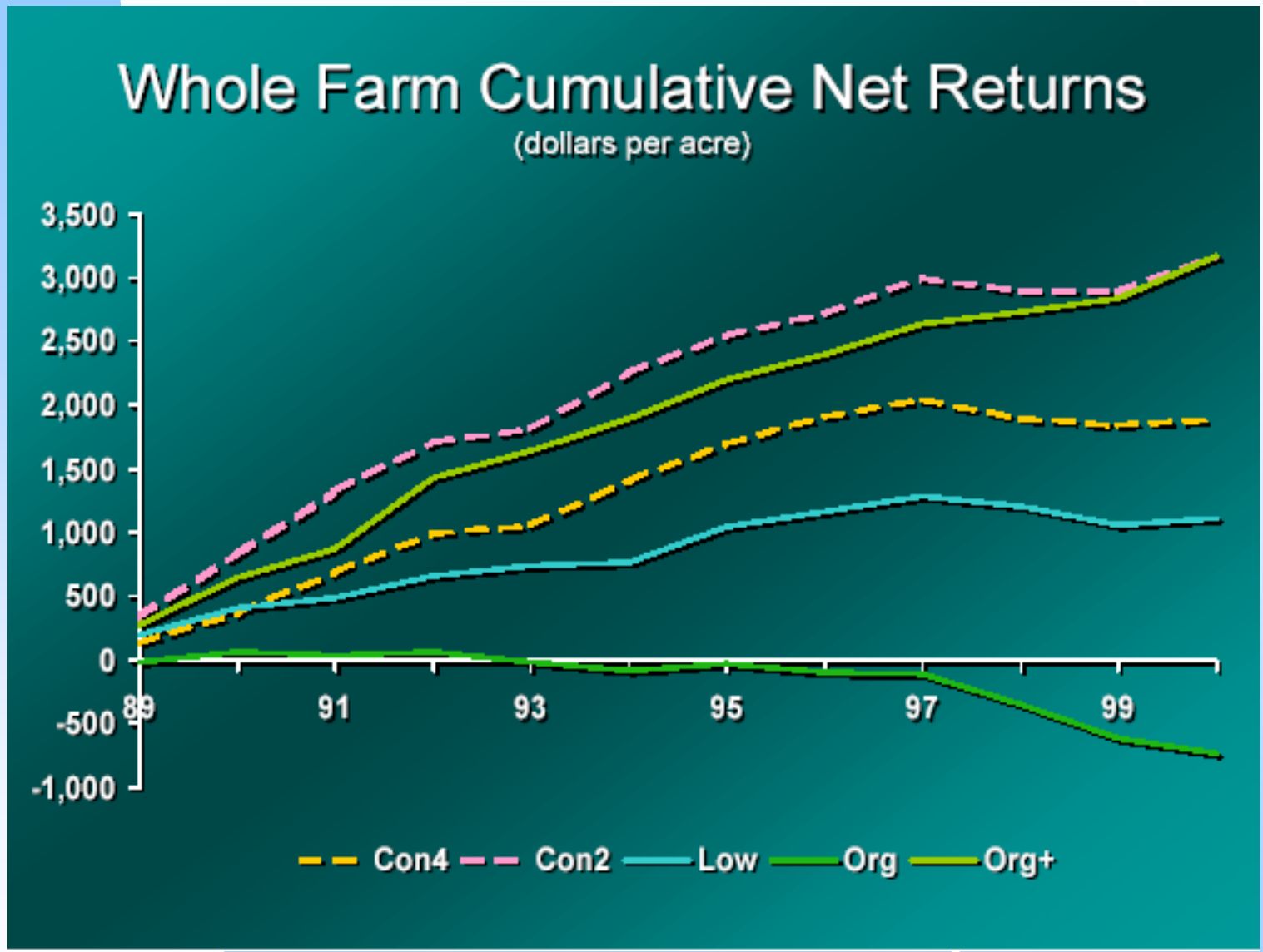

Sustainable Ag Trial – California

(Huyck et al., 2003)

Ecolabels for Sustainable Production

Marketing sustainability:

- **Know your consumer**
- **Clear, credible message**
- **Distinguish self-interest, altruism**
- **Benefits to growers in addition to price premium**

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Importance of environmental sector to consumers

(% responses very high and high)

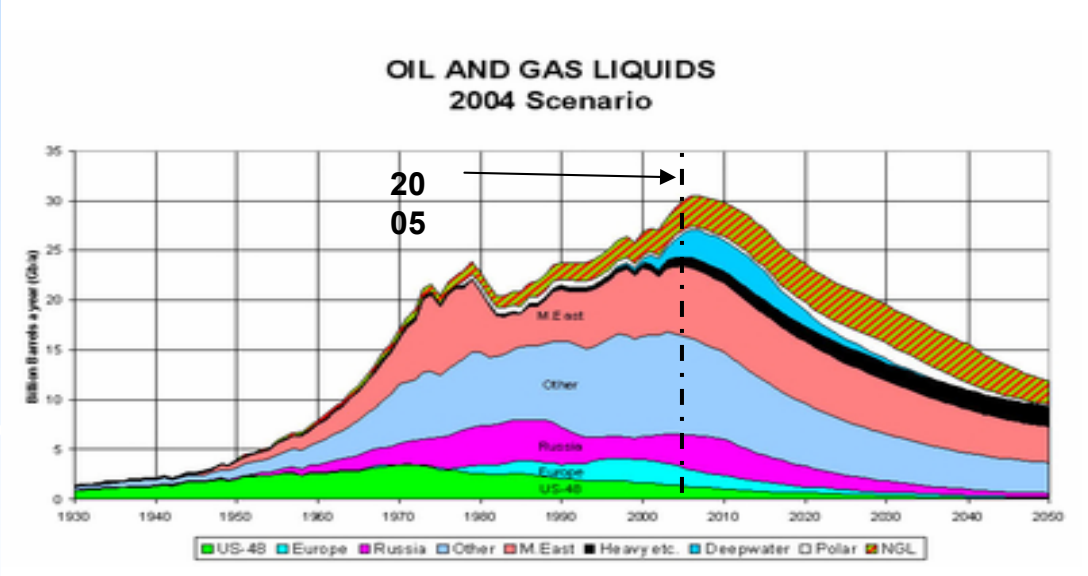
Environmental Sector	Total
Water	57
Air	22
Habitat	11
Soil	6
Energy	5

(Hartman, 1997)

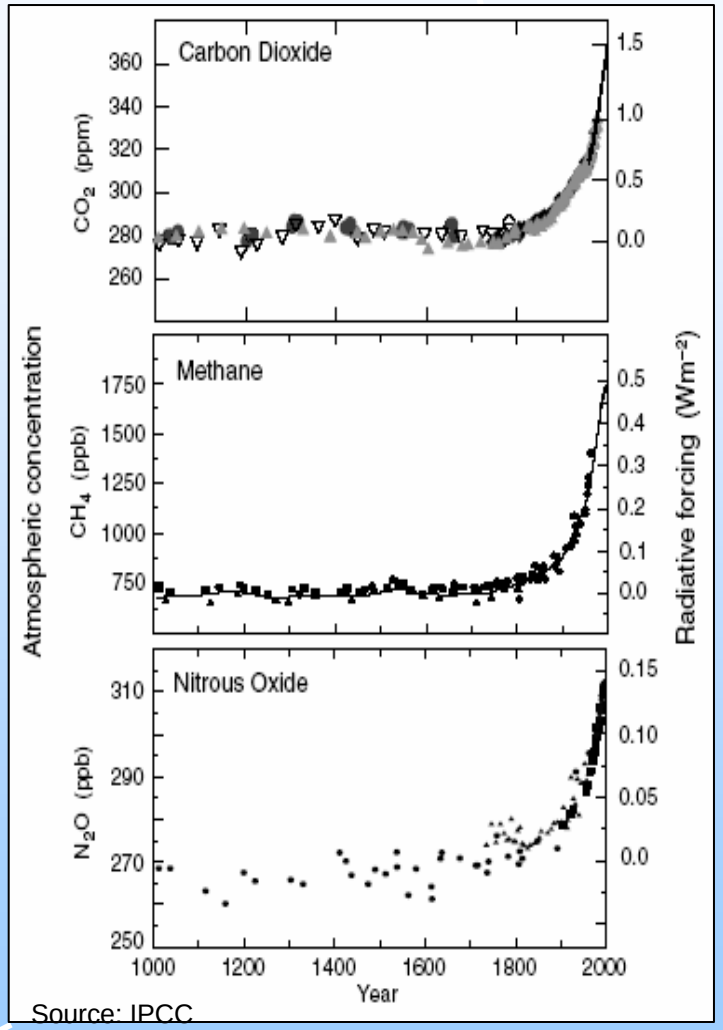
Future Sustainability

Mega-trends:

- Peak oil
- Climate change



Campbell, C. 2004



Source: IPCC

Future Sustainability

Likely trends:

- Mechanization to reduce labor
- Nutritional / nutraceutical content
- Greater importance of 'local'

Mechanical cherry harvest

- Blurring of lines – conventional vs. organic – more integration of good ideas
- Is IFP or Organic more sustainable?

Ultimate impact = sustainability gain x area (e.g. 100% IFP in New Zealand apple, 50% pesticide reduction; 5% organic apple in WA)