





Organic Tomato Production From Heirlooms to High Tunnels

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Brief History of Organic Ag. Certification




- 1990: National OFPA--Organic Food Production Act (OFPA)
- Three years between last application of synthetic fertilizers/pesticides
- 2002: National Organic Program Rules in place
- All certifiers accredited by USDA (OCIA, MOSA, ICS, etc.)
- Iowa (IDALS) Organic Program/16 states have public organic programs



ISU Organic Projects

- Neely-Kinyon Farm, Greenfield, IA (50 acres certified)
 - LTAR (corn, soybeans, oats, wheat, alfalfa)
 - Bean leaf beetle/aphid management
 - Soybean variety trials
 - Organic sweet corn
 - Organic grapes
 - Organic tmnts. for soybean rust
- Grape and apple on-farm trials
- No-Till organic tomatoes and grains
- Organic heirloom tomatoes (Vivian Bernau)







- National Institute of Health Echinacea and St. John's wort
- Crawfordsville Organic Rotations (organic seed)

Organic Tomato Production

- Healthy soil
 - Crop rotations (previous crop: cover crop best; N-supplying crop or lower N-demanding crop)
 - Compost applications (no more than 120 lb N/acre)
- Appropriate cultivars
 - Disease-tolerant/nematode-resistant
 - Heat-tolerant for high tunnels in summer
- Pest management schemes (hand-picking and/or organic sprays)
 - Insectary plants feed beneficial insects
 - Weeds managed through tillage and/or mulch (plastic must be removed at end of season)
 - Straw mulch: thick layer (6 to 12 inches)



Organic Pest Management

- Resistant/tolerant cultivars
- Bio-diversity on farm
- Conservation of beneficial insects
- Preventative (row covers)
- Least toxic, NOP-compliant pesticides






Heirloom Vegetables: Good for High-End Restaurants/Farmers' Markets



Heirlooms:
Higher disease incidence
Superior Taste



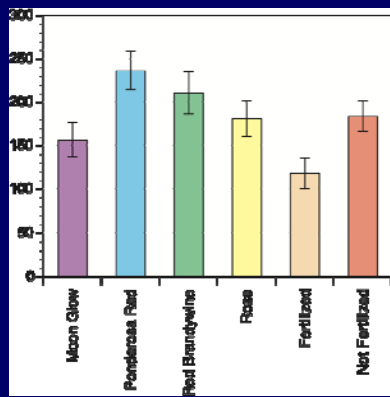
Hybrids:
Higher disease resistance
Not as juicy

PFI farmer-researcher Laura Krouse and John Aselage (Gerber Foods) discuss Organic Ag. on-farm trial.

Heirloom tomato experiment



Staking and trellising helps prevent disease spread

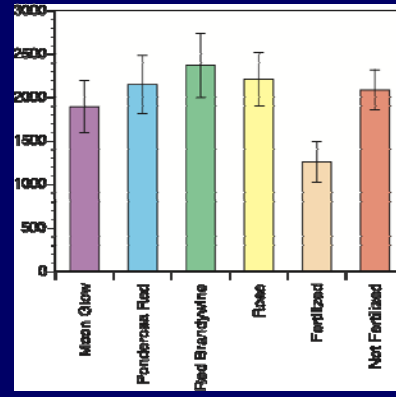


Individual fruit weight

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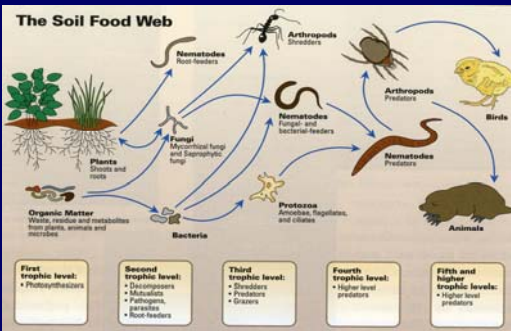
Weights: 5 to 9 ounces



Total harvest weight

Weights: 4 to 5.5 lb/plant

Maintaining the soil food web



Maintaining or Improving Soil Quality

- Crop rotations
- Compost
- Cover crops (tilled and no-till)
- Amendments



Using Cover Crops

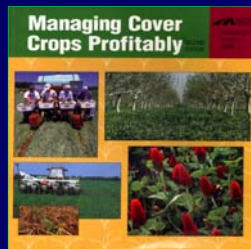
- Provide nitrogen
- Add carbon (biomass)
- Protect soil from erosion
- Weed management
- Provide habitat for wildlife and beneficial insects
- Reduce inputs/create new source of income

Total Nitrogen Source

- Hairy vetch: 90-200 lb. N/A
- White clover: 80-200
- Sweetclover: 75-200
- Berseem clover: 75-220
- Austrian winter peas: 90-150
- Red clover: 70-150
- Kura clover: 75-200
- Medics: 50-120

For high N crops, cover crops + compost best

- Crops take up 30-60% of N produced by cover crop
- Usually additional N is required: compost or organic fertilizer
- Fish emulsion as complement



Killing cover crops

- Incorporation: Derive most N benefit
- Leaving residue on surface: Weed suppression, moisture retention, soil conservation
- Strip-tilling: Leave as dead mulch or live mulch between plant rows
- Mechanical killing: rotary mowing, flailing, sub-soil shearing with undercutter; chopping/flattening with rolling stalk chopper; mowing and tilling under; **rolling/crimping**

Choppers and rollers



Stalk chopper



Front-mounted roller

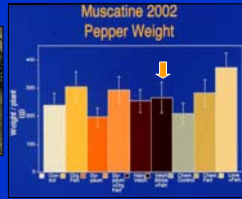
Cover Crops Research-Iowa

- Hairy vetch + winter rye @ 70 lb/acre each
- Recommended rate: 25-40 lb/A-broadcast
- 15-20 lb/acre drilled
- With rye: 40-70 lb/acre
- Irrigation is helpful
- Vetch strips: mowed to kill; 15" strip cut in mulch for pepper transplants
- Incorporated vetch: mowed and tilled mid-May-planted June 1

Tilled and strip-tilled cover crops



Compost plus Strip-Tilled Cover Crop: Best Combination



Transplanting organic vegetables into tilled under cover crops or strip-tilled cover crops.

Delate, K. H. Friedrich and V. Lawson. 2003. Organic pepper production systems using compost and cover crops. *Biol. Ag. and Horticulture* 21 (1): 131-150.

Rodale's No-Till Plus One-Pass System



Front-mounted roller
No-till drill on rear



Fluted coulters cut through crushed cover crop residue



No-Till Plus Project first cropping season wraps up. Farmer and researcher collaborators take stock of what worked and what didn't and prepare for improvement in 2007. Edited by Dan Sullivan



No-Till vegetables in Virginia with Dr. Ron Morse



<http://www.newfarm.org/features/0104/no-till/index.shtml>

Michigan State's schedule

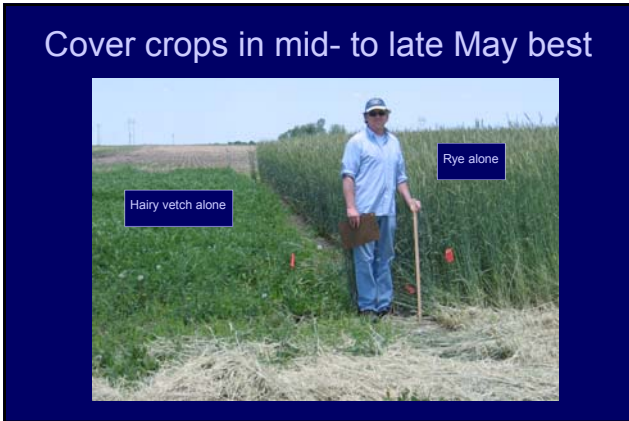
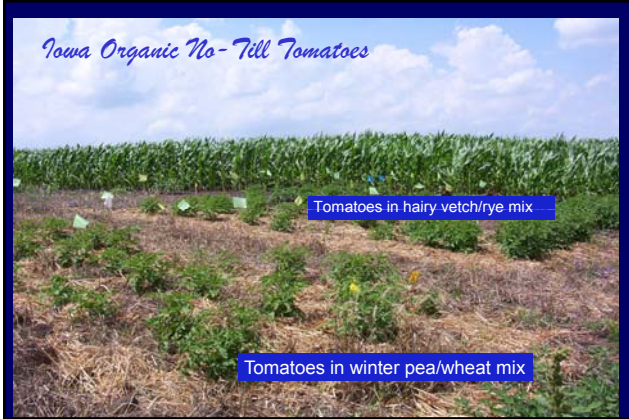
T#	Cover crop planting date	Cropping/Planting					
		Rye (bu/A)	Wheat (bu/A)	May 25	June 2	June 5	June 15
1	Sept. 10	2.5	0	--	--	striped/striped	rip/striped
2	Sept. 10	2.5	0	--	striped	striped/striped	rip/striped
3	Nov. 16	5.5	0	--	--	rip/striped	rip/striped
4	Aug. 24	0	30	striped	striped	striped/striped	rip/striped
5	Aug. 24	0	30	--	striped	striped/striped	rip/striped
6	Aug. 24	0	30	--	--	striped/striped	rip/striped
7	Aug. 24	2	25	--	--	striped/striped	--
8	Aug. 24	2	25	--	striped	striped/striped	rip/striped
9	Aug. 24	2	25	--	striped	striped/striped	rip/striped
10	weed free	2	--	relay mowed	relay mowed	--	planted
11	weed free	0	--	relay mowed	relay mowed	--	planted



- Prepare to re-plant if poor stand of seedlings
- Transplants can go in once cover crop is dead

Petroleum savings

Operation	Soybean systems**	
	Diesel fuel (gal/acre)	
	Current system	Proposed system
Roll & crimp cover crops	-	0.10
Moldboard plw	1.70	-
Disk	1.30	-
Field cultivate (2X)	1.40	-
Till planter	0.55	-
No-till planter	-	0.45
Rotary hoe (2X)	0.40	-
Cultivator (3X)	1.20	-
TOTAL	6.55	0.55



'One-pass' planting for seeded crops



No-Till Plus Schedule—2006

Cover crops planted: September 12, 2005
Rolled: May 25 (2-3 times)
Transplant tomatoes: June 15
Straw applied June 27
Harvest: August 14-September 26

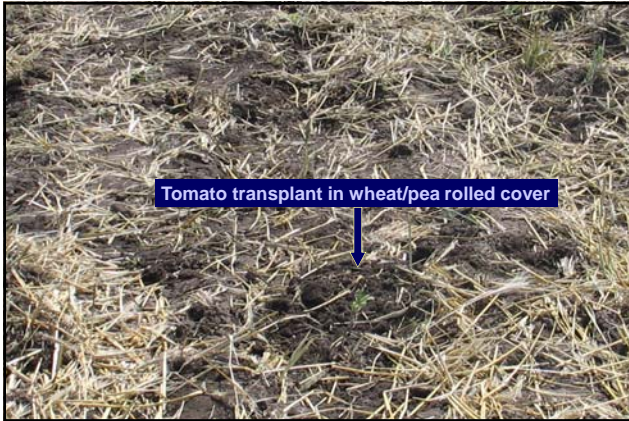
The Rodale Institute No-Till 'Roller' used in rolling the cover crops before transplanting organic tomatoes.



Cover crops

- Hairy vetch (32 lb/acre) + rye (1 bu/acre)
 - Winter wheat (1 bu/acre) + Austrian winter pea (19 lb/acre)
- Combination cover crop mix from Albert Lea Seed House, MN





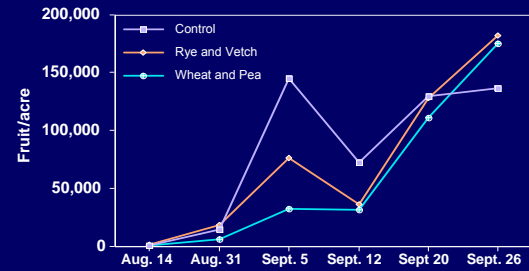
Weed populations and disease occurrence in No-Till Plus trial, Neely-Kinyon, 2006

Treatment	Weed Populations (weeds/m ²)				Disease (%) July 11, 2006
	July 20, 2006		August 14, 2006		
	Broadleaves	Grasses	Broadleaves	Grasses	
No Cover	16.00b	18.44	0.11	0.85a	4.89
Rye and Hairy Vetch Cover	1.22a	10.78	0.11	0.82a	6.11
Wheat and Winter Pea Cover	0.89a	7.89	0.11	17.52b	7.37
LSD 0.05	8.79	NS	NS	14.51	NS

Yield and tomato quality in No-Till Plus trial, Neely-Kinyon, 2006

Treatment	Yield (fruit/acre)	Tomato quality (%)		
		Grad 1	Grad 2	Grad 3
No Cover	497,875	79.53	9.13b	11.34
Rye and Hairy Vetch Cover	441,731	87.74	5.26a	6.99
Wheat and Winter Pea Cover	355,579	85.34	7.14ab	7.52
LSD 0.05	NS	NS	2.74	NS

Tomato yield in No-Till Plus trial, Neely-Kinyon, 2006



Rain-fed organic no-till soybeans 45 bu/acre



The benefits of no-till

- No mechanical tillage
- Less soil erosion
- Moisture conservation
- Lower weeding costs
- Michigan 2004: 60 bu/acre soybeans
- Pennsylvania 2006: 30 bu/acre soybeans

Constraints of no-till

- Moisture-robbing when rains are limited
- Cover crop may not die: re-grows after crushing, causing competition with crop
- Cover crop may provide insufficient cover, allowing weeds to emerge in open areas
- Roller may compact soil (tests underway)

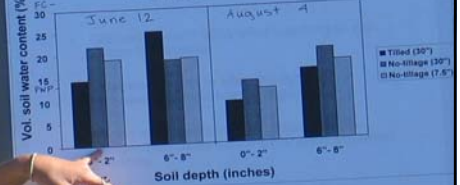
System may not work well

- If cover crop biomass is insufficient
- Gaps in cover crops
- Low moisture: crop cannot compete
- Weeds take advantage



No-till has less soil water at planting; more 2 months later

Effect of Rye/Tillage and Row Spacing on Soil Water Content



High Tunnel (hoophouse) – A poly-covered greenhouse with relatively low input for environmental control (relatively low cost)



30' x 96' Gothic
Zimmerman's, Versailles, MO

30' x 96' Quonset with stove
FarmTek
Versailles, MO

-Ted Carey, Kansas State Univ.

Some roll down

Solar powered roll-down side.
Bryan Boeckmann, Rocky Top Farm, MO



Hightunnels.org

Welcome

News

For Educators

For Growers

Resources

About Us

High tunnels, or hoophouses, are unheated greenhouses that can help market gardeners extend their growing season so that they can improve the profitability of their farms. This website is part of a USDA-sponsored project that is testing and promoting high tunnel systems in the Central Great Plains. We hope to provide information developed under our project, and links to relevant sites around the world, so that growers and educators have a one-stop source where they can find information on all aspects of high tunnel construction and use.

Hans Davis, Charutha, Peter Loth, Ohio State Univ.

Ted Carey, Kansas State Univ.

We welcome your input and feedback to make this site useful. Please let us know of links to

Advantages of a High Tunnel:

- Low-cost
- Highly productive
- Crop protection
 - disease, pest
 - quality
- Season extension
- Facilitates diverse production
- Supplement field production



Ted Carey, Kansas State Univ.

Costs of high tunnels

- Per structure or per square foot
 - $\$3500 / (30' \times 96') = \$1.22/\text{sq. ft.}$
- Including extras, labor and freight
 - $\$3500 + \$1500 = \$5000$ ($\$1.76/\text{sq. ft.}$)
- Spread out over time (10 years)
 - $\$500/\text{year}$
- Operating costs/management

Ted Carey, Kansas State Univ.

Costs of high tunnels (roughly)

- FarmTek, Atlas, Stuppy
 - $\$1200 / (18' \times 24') = \2.77 sq. ft.
 - $\$5000 / (30' \times 96') = \1.74
- Haygrove
 - $\$22,000 / (96' \times 200') = \1.15
- Homemade
 - $\$1000 / (14' \times 100) = \0.71
 - $\$500 / (18' \times 30) = \0.93

Ted Carey, Kansas State Univ.

High tunnel tomato budgets

- Costs (fixed and variable) and prices

Penn State – 17' x 96'
 $\$2,000$ @ $\$0.80/\text{lb}$ (16 lb/plant)
 breakeven $\$0.36/\text{lb}$

University of Missouri – 20' x 96'
 $\$2,720$ @ $\$1.00/\text{lb}$ (8 lb/plant)



Steve Groff

Cedar Meadow Farm, PA

Ted Carey, Kansas State Univ.



Florida 91

Florida 91 – heat set type

Planted – 5/26
 2' x 3'

Organic – 120 lb N compost
 + fish emulsion 30 lb N
 Conventional – 60 lb N +
 calcium nitrate

Septoria leaf blight – in field

Hornworm, fruit worm – Spinosad (Entrust or Spintor)

Ted Carey, Kansas State Univ.



Pest problems: different, not necessarily lower

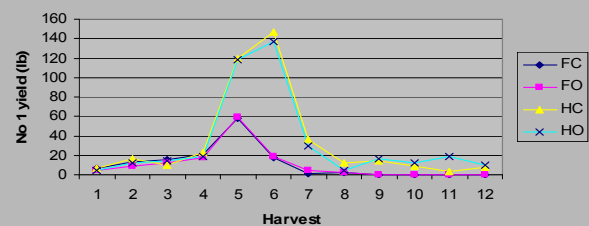


High Tunnel: Lower Septoria disease
 Can get higher powdery mildew
 Whiteflies, mites and aphids

Ted Carey, Kansas State Univ.

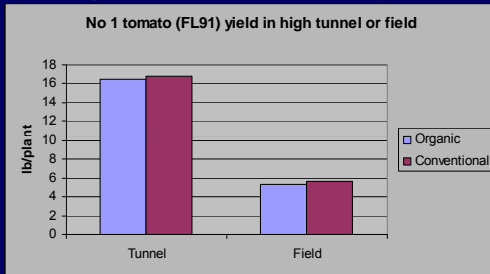
Higher tomato yields in high tunnel in summer

Florida 91 tomato harvest 7/28 to 10/10/05



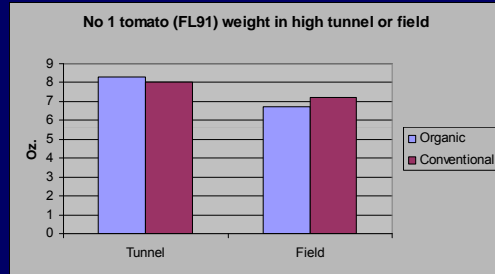
Ted Carey, Kansas State Univ.

Higher yields in high tunnels; similar organic and conventional yields



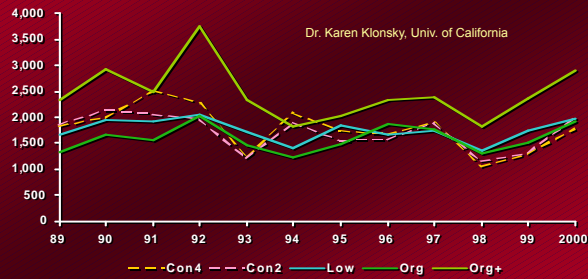
-Ted Carey, Kansas State Univ.

Heavier tomatoes in tunnel vs. field



-Ted Carey, Kansas State Univ.

Tomato Gross Returns (dollars per acre)



Organic premium price is necessary for maximum profit

ISU Organic Webpage

Organic Agriculture

- home page
- calendar
- research and education production
- resources
- regulations
- other links

Welcome to the Iowa State University Organic Agriculture website. Our mission is to educate producers, consumers and policy makers in the research and extension activities in Organic Agriculture both on farm and in the universities.

Organic Agriculture involves a production management system based on the ecological principles of nutrient cycling, biotic regulation of pests and biodiversity. Synthetic fertilizers and pesticides are replaced by sunlight based inputs, such as plant and animal residues. Premium prices for certified organic products drive the immediate economic benefits of Organic Agriculture. Long term benefits to human and environmental health are also derived through these practices. We encourage you to explore this website and send us your comments at news@iaa.org

If you would like to subscribe to our mailing list for additional information, please contact dora.zobus@iastate.edu (515) 294-6116.

• NEW:
 * November 21, 2004: [Soybean Rust and Organic Soybean Production](#)
 * November 8, 2004: [News release-Fourth Annual Iowa Organic Conference](#)

<http://extension.agron.iastate.edu/organicag/>