Making the CT Paradigm Work in Processing Tomatoes
UCCE Northern SJV Processing Tomato Meeting
February 2, 2012

Thanks for the opportunity to be with you this morning in Modesto!
Welcome to CASI!
USDA
Agricultural Research Service
National Program 216
Agricultural Systems Competitiveness and Sustainability
CONSERVATION AGRICULTURE

...links production with sustainability.
‘The agronomic and ecological equivalent of the moon race of the 1960’s’

Dwayne Beck, 2012
‘They did not achieve a successful landing by testing small incremental improvements in rocket design. They did it by having a specific goal and teams focused on developing the techniques required to achieve that goal.’
Our Energy Goal

_Total farm and processing net energy self sufficiency by 2012 for all types of energy_

We aim to achieve this goal while taking into account:

1. Carbon neutral or negative
2. Nitrous-oxide neutral or negative
3. Use non-food sources for energy
4. Energy costs should be reasonable
5. Maintain past growth of about 30-35% annually, doubling every 2-3 years
‘…Take all net geologic carbon use out of the system by the year 2026…. In other words, no net loss of organic matter…

A corollary goal is to stop all nutrient leakage from the land (recycle all that is not sold). This includes stopping the leakage of C.

Once these goals are accepted, we can finally get over this need to compare tillage systems. It’s not about the tillage practice. It is about managing the ecosystem.

Tillage removes our ability to manage the system.’

Dwayne Beck
March 7, 2006
Sustainable agriculture

- Crop rotation
- Intensity of soil disturbance
- Surface crop retention

Conventional agriculture: Conventional, Minimum Tillage, Direct seeding
Conservation Agriculture worldwide 117 Million ha

- Kazakhstan: 1M ha
- Canada: 13.5M ha
- Europe: 1M ha
- China: 1M ha
- USA: 26.5M ha
- Africa: 0.5M ha
- Brazil: 26M ha
- Argentina: 26M ha
- Paraguay: 2.5M ha
- Australia: 17M ha
- Other Latin America: 2M ha

- Large scale: >50%
- Large scale: >70%
- Large scale: up to 90%
- Smallholder: <25%
- Subtropical, dry: other LA 2
- Temperate, moist: temperate, moist
- Tropical savannah: tropical savannah
CA Adoption in percent by region worldwide

- South America
- North America
- Australia, New Zealand
- Europe
- Africa
- Asia
It is estimated that in less than a decade > 85% of the cultivated area will be under No-till.

(Derpsch & Friedrich, 2008)
Brazil - Area under CA from 1972 to 2006

Argentina - CA from 1977 to 2006

CA globally - history and adoption


No-Till Adoption in the U.S.
1994 - 2004

Estimated farmer adoption of no-till in WA

Starting of GTZ/MAG Soil Conservation Project
(Source: CAPECO-MAG)
History and Adoption of CA

- **US Soil Conservation Service**: Conservation tillage
- **Faulkner (US) – Fukuoka (Japan)**: First no-till in the US
- **Dustbowl**: Dustbowl in Siberia/USSR
- **First no-till/US**: Commercial no-till demonstration in Brazil
- **Oldrieve/Zimbabwe**: Adoption Brazil plantio direto na palha
- **Argentine, Paraguay**: Experiments in China, Indogangetic Plains
- **Russia, China, Finland... Africa**: New boost

- **1930**: Dustbowl
- **1950**: First no-till in the US
- **1970**: Commercial no-till demonstration in Brazil
- **1980**: Adoption Brazil plantio direto na palha
- **1990**: Argentina, Paraguay; experiments in China, Indogangetic Plains
- **2000**: Russia, China, Finland... Africa

Mill. ha
Silage wheat chopping ahead of tomato transplanting
Turkey
2009
Tomato transplanting following silage wheat chopping
Turkey
2009
Changes in Tillage Management in California’s Central Valley

'DRIVERS' FOR CHANGE

1930s
Dryland Farming
“Pump Era” - Advent of limited irrigation

1957
Shredder Bedder
--Al Ruozzi, Interstate Mfg. (Bakersfield, CA)

1963
California Aqueduct
Central Valley Improvement Project (Expansion of irrigation)

1970s
Wide tractive “spanner” implement (Controlled traffic research)
--Lyle Carter, USDA (Shafter, CA)

1980s
Declines in prices for agricultural products
No-till dryland small grain production
(Yolo, Tulare and San Luis Obispo)
“Zone tillage,” --Lyle Carter, USDA (Shafter, CA)

1990s
No-till and ridge-till corn, beans, and wheat
--Ralph Cosena, Sr. (Stockton, CA)

1993
Hahn Bed Disk
Wilcox Performer
New World Tillage Incorpramaster

1994
No-till tomato research --Jeff Mitchell (Five Points, CA)

1996
CT Workgroup formed

1999
No-till cotton/tomato long-term research (Five Points, CA)
New World Tillage Optimizer

2000
No-till and strip-till cotton farm studies --Bob Prys (Riverdale, CA)

2003
Wilcox Eliminator

2004
Strip-till tomatoes --Steve Fortner and Fred Leavitt (Firebaugh, CA)

2005
Strip-till and no-till daily silage --Tom Barcellos (Tipton, CA)

2008
Coupling CT with overhead irrigation --John Diener (Five Points, CA)
### Increases in CT 2004 – 2010 in California

<table>
<thead>
<tr>
<th>Year</th>
<th>No Till</th>
<th>RT/ST</th>
<th>Mulch Till</th>
<th>Subtotal</th>
<th>Minimum Tillage</th>
</tr>
</thead>
<tbody>
<tr>
<td>2004</td>
<td>5,265</td>
<td>690</td>
<td>51,150</td>
<td>57,105</td>
<td>64,613</td>
</tr>
<tr>
<td>2006</td>
<td>17,181</td>
<td>9,020</td>
<td>42,964</td>
<td>69,165</td>
<td>318,006</td>
</tr>
<tr>
<td>2008</td>
<td>27,308</td>
<td>121,055</td>
<td>79,434</td>
<td>227,797</td>
<td>416,035</td>
</tr>
<tr>
<td>2010</td>
<td>32,387</td>
<td>157,824</td>
<td>96,267</td>
<td>286,478</td>
<td>701,760</td>
</tr>
</tbody>
</table>

*Note: The chart and table above illustrate the increases in Conservation Tillage (CT) practices in California from 2004 to 2010, focusing on No Till, RT/ST, Mulch Till, Subtotal, and Minimum Tillage.*
Aref Abdul-Baki
USDA ARS
Beltsville, MD

Dwayne Beck
SDSU
Pierre, SD

Andy McGuire
Moses Lake, WA

Dick and Sharon Thompson
Boone, IA

Karl Kupers
Rearden, WA

Ron Morse
Virginia Tech
Blacksburg, VA

John Luna
Oregon State University
Corvallis, OR

Steve Groff
Lancaster County
Pennsylvania

Mike Peterson
Greeley, CO

Don Reicosky
USDA ARS
Morris, MN

John Landers
Cerrado Region
Brazil
New technology practiced on Tracy man’s farm

Jonathan Partridge
The Tracy Press

Close to 30 people from all over Northern California gathered at Hal Robertson’s Tracy farm on Friday morning to discuss ways to use less tilling for tomato fields.

The University of California sponsored “Reduced Tillage Field Day,” which informed farmers about experiments UC researchers are doing to reduce the amount of tractor work done on fields — and reduce erosion in the process.

One of the largest UC experiments is being conducted on Robertson’s farm, and spectators could look at the results on Robertson’s tomato field firsthand on Friday.

“[The UC cooperative] extension office gets excited about this stuff, so it got me excited,” Robertson said.

The Tracy farmer experimented on the experiments in his field. He attributes the Midwest’s greater experience with these growing methods to erosion requirements that those states impose on their farmers, which California doesn’t.

Ralph Cesaña, who sells equipment using this technology in California and Mexico, said many Californians are actually opposed to using reduced-tillage methods, and he was surprised at the amount of people who attended Friday’s meeting.

“I was shocked when I first came [to California],” Cesaña said. “I thought people would be more attuned to it, since they have so much information.”

But Benny Fouché, farm adviser for the University of California Cooperative Extension in San Joaquin County, said many farmers in the county are interested in new technology.

“Our growers may seem like your run-of-the-mill conservative dirt farmers, but they’re actually very innovative,” he said. “They continue to impress me.”

George Johannsen of Danville, a former horticulturist for the California Tomato Research Institute, said the Robertson family is particularly innovative.

“We’ve got one of the finest growers here in the county with the Robertsons,” he said. “And Hal is one of the finest leaders here in agriculture.”
The ‘early’ history - 1994
First ever subsurface drip coupled with permanent beds and strip-till cover cropped fresh market tomato production
Firebaugh, CA
2003
Sano Farms, Firebaugh, CA
since 2004
Frank Coelho
Five Points, CA
Danny Ramos
The Morning Star Company
Los Banos, CA
First ever subsurface drip coupled with permanent beds and strip-till cover cropped fresh market tomato production
Firebaugh, CA
2003
The research base

From 1999, ongoing work with CT tomato and cotton systems in Five Points, CA
Conservation / Standard Tillage Comparison Study
(1999 – ongoing)

Standard Tillage
- With cover crop
- Without cover crop

Conservation Tillage
- With cover crop
- Without cover crop
Rainfed winter cover crop being seeded into cotton and tomato residue. Five Points, CA 2007
Winter, rainfed triticale, rye and pea cover crop no-till seeded into cotton and tomato residues
Five Points, CA 2008
Tillage and cover crop system erosion estimates, soil condition index sub-factors, soil tillage intensity rating and estimates of diesel fuel use.

<table>
<thead>
<tr>
<th>Cropping System*</th>
<th>Erosion Estimates RUSLE2 (Mg ha⁻¹)</th>
<th>Conditioning index</th>
<th>STIR Average Annual</th>
<th>Diesel fuel use</th>
<th>Fuel cost for entire simulation ($)</th>
</tr>
</thead>
<tbody>
<tr>
<td>STNO</td>
<td>0.2</td>
<td>-0.71</td>
<td>261</td>
<td>32</td>
<td>128.6</td>
</tr>
<tr>
<td>STCC</td>
<td>0.07</td>
<td>-0.96</td>
<td>390</td>
<td>40</td>
<td>160.6</td>
</tr>
<tr>
<td>CTNO</td>
<td>0.04</td>
<td>0.43</td>
<td>30.6</td>
<td>9.3</td>
<td>36.8</td>
</tr>
<tr>
<td>CTCC</td>
<td>0.03</td>
<td>0.52</td>
<td>37.1</td>
<td>11</td>
<td>43.27</td>
</tr>
</tbody>
</table>

* STNO = Standard tillage no cover crop, STCC = Standard tillage with cover crop, CTNO = Conservation tillage no cover crop CTCC = Conservation tillage with cover crop.
Cultural costs for standard tillage (ST) versus conservation tillage (CT) for processing tomato, Westside Field Station, 2003 (operations expensed at 2007 input prices)

<table>
<thead>
<tr>
<th>Cultural costs</th>
<th>ST</th>
<th>CT</th>
<th>Difference (ST-CT)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fertilizer</td>
<td>79</td>
<td>79</td>
<td>0</td>
</tr>
<tr>
<td>Seed</td>
<td>176</td>
<td>176</td>
<td>0</td>
</tr>
<tr>
<td>Herbicide</td>
<td>76</td>
<td>70</td>
<td>6</td>
</tr>
<tr>
<td>Insecticide</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Water</td>
<td>163</td>
<td>163</td>
<td>0</td>
</tr>
<tr>
<td>Labor (machine)</td>
<td>36</td>
<td>19</td>
<td>17</td>
</tr>
<tr>
<td>Labor (irrigation)</td>
<td>110</td>
<td>110</td>
<td>0</td>
</tr>
<tr>
<td>Labor (hand weed)</td>
<td>84</td>
<td>84</td>
<td>0</td>
</tr>
<tr>
<td>Fuel</td>
<td>58</td>
<td>21</td>
<td>37</td>
</tr>
<tr>
<td>Lube and repair</td>
<td>34</td>
<td>16</td>
<td>18</td>
</tr>
<tr>
<td>Interest</td>
<td>36</td>
<td>31</td>
<td>5</td>
</tr>
<tr>
<td><strong>Total cultural</strong></td>
<td>853</td>
<td>770</td>
<td>83</td>
</tr>
</tbody>
</table>
### Soil Carbon weights (t/ha)

<table>
<thead>
<tr>
<th>Depth (cm)</th>
<th>Standard Till</th>
<th>Standard Till</th>
<th>Conservation Tillage</th>
<th>Conservation Tillage</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>No Cvr Crop</td>
<td>Winter Cvr Crop</td>
<td>No Cvr Crop</td>
<td>Winter Cvr Crop</td>
</tr>
<tr>
<td>0-15</td>
<td>10.74 (0.28)</td>
<td>13.68 (0.43)</td>
<td>14.51 (0.61)</td>
<td>15.95 (3.43)</td>
</tr>
<tr>
<td>15-30</td>
<td>11.59 (0.43)</td>
<td>13.69 (0.73)</td>
<td>11.69 (0.45)</td>
<td>12.89 (0.54)</td>
</tr>
<tr>
<td>Total</td>
<td><strong>22.33</strong> C</td>
<td><strong>27.37</strong> B</td>
<td><strong>26.20</strong> B</td>
<td><strong>28.84</strong> A</td>
</tr>
</tbody>
</table>

Values in parentheses are standard error of the means (n=8); north and south field mean averages were not significantly different therefore treatments combined for analysis.

Letters represent significant differences among treatments using a one-way ANOVA analysis with Tukey HSD means comparison.

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### No-till cotton production following tomato
Five Points, CA • 2000 - 2010
"Scaling up" conservation tillage techniques at commercial processing tomato farm
Firebaugh, CA
2008
Fall tillage using Wilcoxon Performer using GPS with permanent subsurface drip beds
20 ft. Great Plains cover crop seeder
Seeding the cover crops on the bed tops only
Typical cover crop growth stage at time of herbicide termination
Typical cover crop growth stage (or do it earlier) at time of herbicide application
Burned down triticale cover crop prior to strip-tilling and transplanting
April 2009
Sano Farm
Firebaugh, CA
Typical burned down cover crop following strip-tilling
Strip-till planted processing tomatoes
Firebaugh, CA 2006
## Comparative preplant tomato production costs for standard, minimum, Sano Farms CT and no-till systems

<table>
<thead>
<tr>
<th>Operation</th>
<th>Standard</th>
<th>Minimum</th>
<th>Sano</th>
<th>No Till</th>
</tr>
</thead>
<tbody>
<tr>
<td>Machine Labor Hours</td>
<td>1.89</td>
<td>0.95</td>
<td>0.55</td>
<td>0.05</td>
</tr>
<tr>
<td>Machine Labor Costs</td>
<td>25.93</td>
<td>12.95</td>
<td>7.59</td>
<td>0.71</td>
</tr>
<tr>
<td>Non-Machine Labor Hours</td>
<td>1.00</td>
<td>1.00</td>
<td>1.00</td>
<td>1.00</td>
</tr>
<tr>
<td>Non-Machine Labor Costs</td>
<td>10.96</td>
<td>10.96</td>
<td>10.96</td>
<td>10.96</td>
</tr>
<tr>
<td>Diesel Gallons</td>
<td>24.58</td>
<td>10.69</td>
<td>5.55</td>
<td>0.30</td>
</tr>
<tr>
<td>Diesel Costs</td>
<td>50.15</td>
<td>21.80</td>
<td>11.32</td>
<td>0.62</td>
</tr>
<tr>
<td>Lube</td>
<td>7.52</td>
<td>3.27</td>
<td>1.70</td>
<td>0.09</td>
</tr>
<tr>
<td>Repair</td>
<td>17.84</td>
<td>7.81</td>
<td>8.19</td>
<td>0.14</td>
</tr>
<tr>
<td>Interest</td>
<td>8.97</td>
<td>6.06</td>
<td>9.74</td>
<td>3.66</td>
</tr>
<tr>
<td>Total Operation Costs</td>
<td>121.37</td>
<td>62.85</td>
<td>49.50</td>
<td>16.18</td>
</tr>
<tr>
<td>Cash Overhead</td>
<td>2.75</td>
<td>1.09</td>
<td>1.72</td>
<td>0.07</td>
</tr>
<tr>
<td>Non Cash Overhead</td>
<td>29.36</td>
<td>11.65</td>
<td>17.42</td>
<td>0.00</td>
</tr>
<tr>
<td>Total Costs (Excluding Materials)</td>
<td>153.48</td>
<td>75.59</td>
<td>68.64</td>
<td>16.25</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Add Materials</th>
<th>Standard</th>
<th>Minimum</th>
<th>Sano</th>
<th>No Till</th>
</tr>
</thead>
<tbody>
<tr>
<td>Water</td>
<td>75.00</td>
<td>75.00</td>
<td>75.00</td>
<td>75.00</td>
</tr>
<tr>
<td>Roundup</td>
<td>8.07</td>
<td>8.07</td>
<td>48.42</td>
<td>8.07</td>
</tr>
<tr>
<td>Cover Crop</td>
<td>0.00</td>
<td>0.00</td>
<td>28.00</td>
<td>0.00</td>
</tr>
<tr>
<td>Total Materials</td>
<td>83.07</td>
<td>83.07</td>
<td>151.42</td>
<td>83.07</td>
</tr>
<tr>
<td>Total Costs (Including Materials)</td>
<td>236.55</td>
<td>158.66</td>
<td>220.06</td>
<td>99.32</td>
</tr>
</tbody>
</table>
2011 Tomato Cover Crop and Strip-till Demonstration Evaluation Sites

Yolo County locations (2)
San Joaquin County locations (2)
Merced County locations (2)
San Benito County locations (1)
Fresno County locations (3)
2012 Conservation Ag and Controlled Traffic Farming Conferences

To be held in: Tulare, Davis, Five Points, and Bakersfield, CA

Don Reicosky
USDA - ARS, MN

Jerry Hatfield
USDA, IA

Tim Chamen
England

Rolf Derpsch
Paraguay

John McPhee
Tasmania
Other sources of information:

The Conservation Tillage Workgroup:

http://ucanr.org/sites/ct/

Jeff Mitchell
(559) 303-9689
Thank you very much.

http://ucanr.org/sites/ct/