CONSERVATION TILLAGE AND OVERHEAD IRRIGATION OPPORTUNITIES IN CANNING TOMATOES

Jeff Mitchell, Karen Klonsky, Rich DeMoura, Will Horwath, Randy Southard, Wes Wallender
University of California, Davis

Gene Miyao, Brenna Aegerter and Dan Munk
University of California

Ron Harben
California Association of Resource Conservation Districts

Thanks to Gene Miyao for the invitation to be with you this morning.

South Sacramento Valley Processing Tomato Production Meeting

January 12, 2011

Collaborators

We thank CTRI and CDFA for their support of our work.

Gene Miyao
Marsha Campbell-Mathews
Anil Shrestha
Carol Collar
Shannon Mueller
Kurt Hembree
Nick Madden
Alejandro Castillo
Steve Temple
Karen Klonsky
Julie Baker
Carol Frate
Howard Ferris
Tom Lanini
Anil Shrestha
Wes Wallender
Willi Horwath
Jaime Solorio
Ed Scott

Dino Giacomazzi
Tom Barcellos
John Diener
Michael Crowell
Ryan Camara
David Wheeler
Frank Gwerder
Richie Iest
Shannon Iest
Danny Petersen
Larry Soares
Daniel Soares
Silas Roussow
Andy Rollin

Bill McCloskey
Steve Husman
Paul Brown

Lyle Carter

Phil Hogan
Rob Roy
Bob Fry
Johnnie Siliznoff
John Beyer (retired)
Rita Bickel
Tom Gohlke

Ron Harben

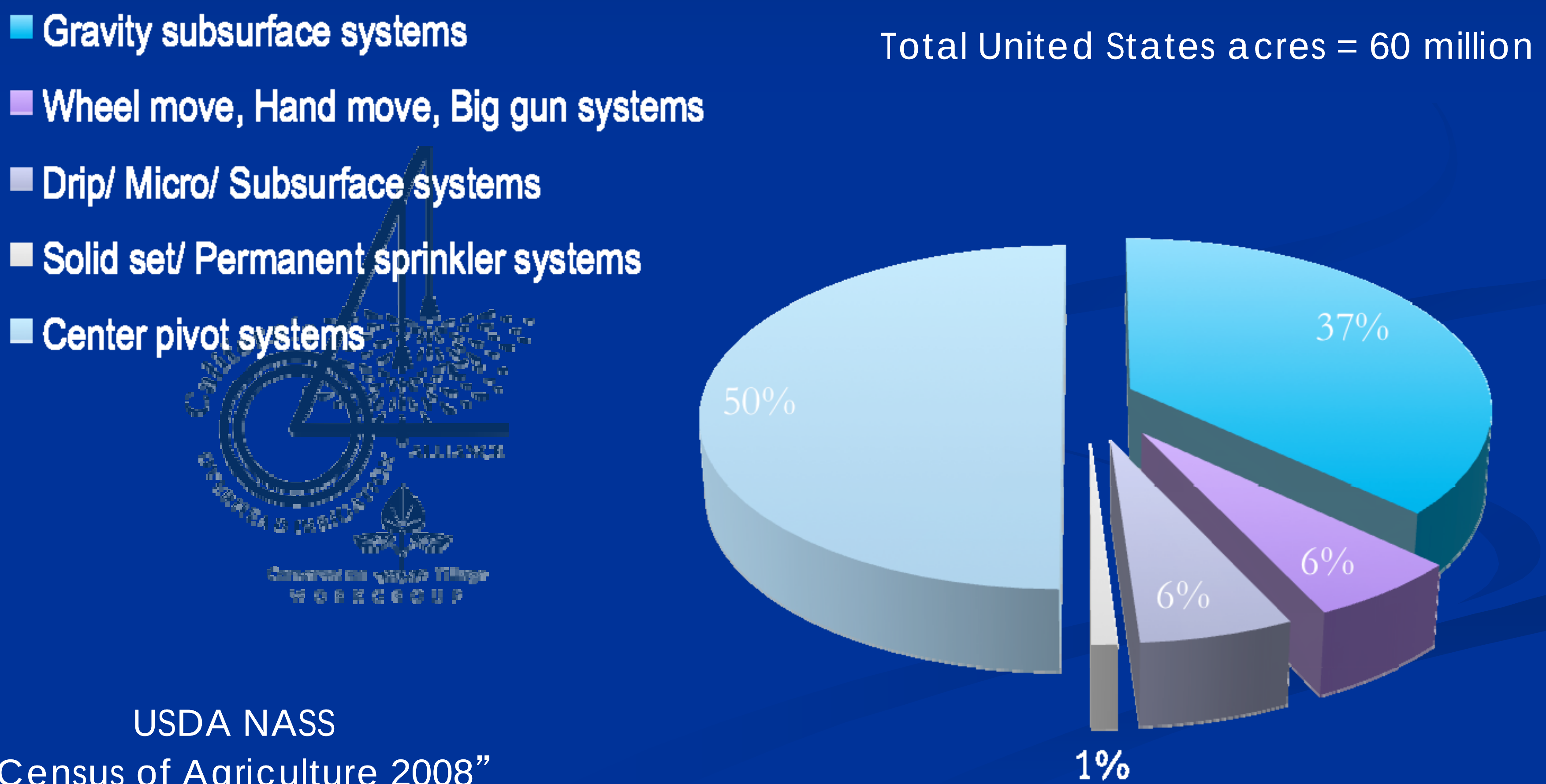
Ray Batten
Wendell Dorsett
Pat Murray
John Bliss
Monte Bottens

Allen DuSault
Joe Choperena
Ladi Asgill

OVERVIEW OF PRESENTATION

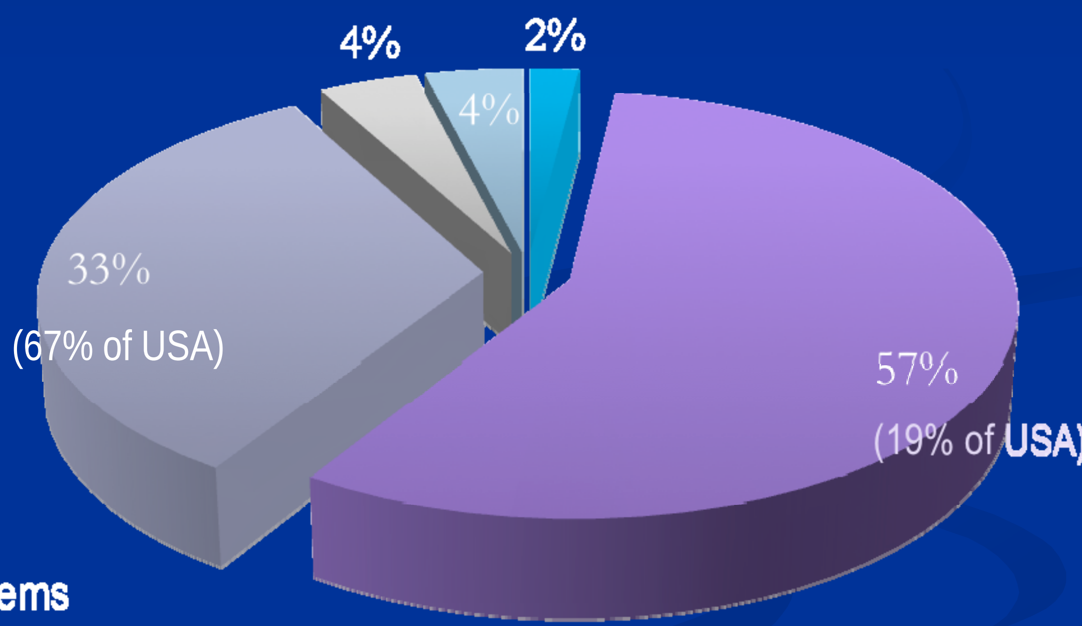
- tomato production using overhead irrigation
- tomato production using conservation tillage and cover crops
- an invitation to take part with us in a short focus group following this meeting

The 2008 U.S. Farm & Ranch Irrigation Survey



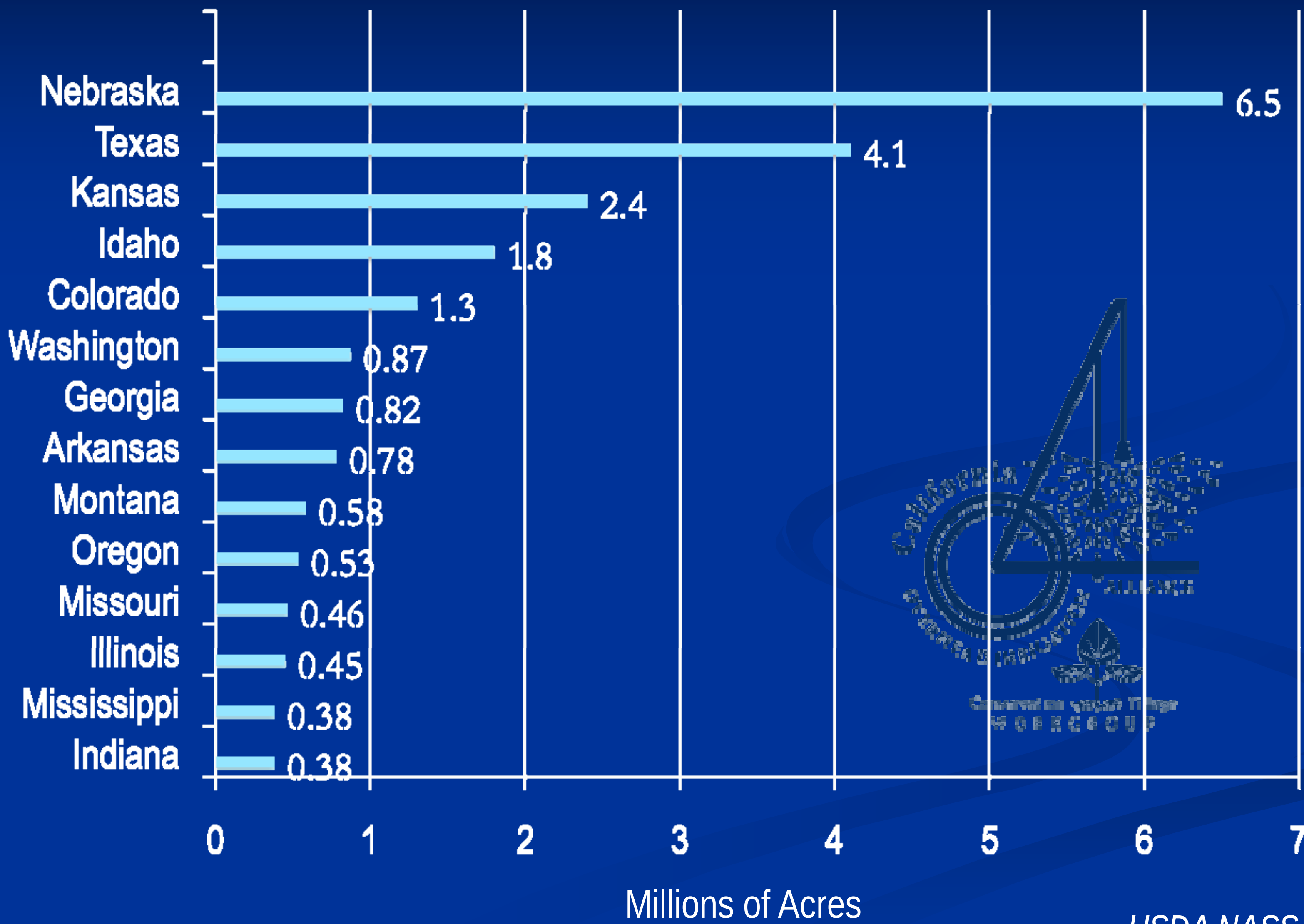
USDA NASS
"Census of Agriculture 2008"

The 2008 California Irrigation Survey



- Center pivot systems
- Gravity surface systems
- Drip/Micro/Subsurface systems
- Solid set/Permanent sprinkler systems
- Wheel move, Hand move, Big gun systems

USA Center Pivot Systems “Top 15”



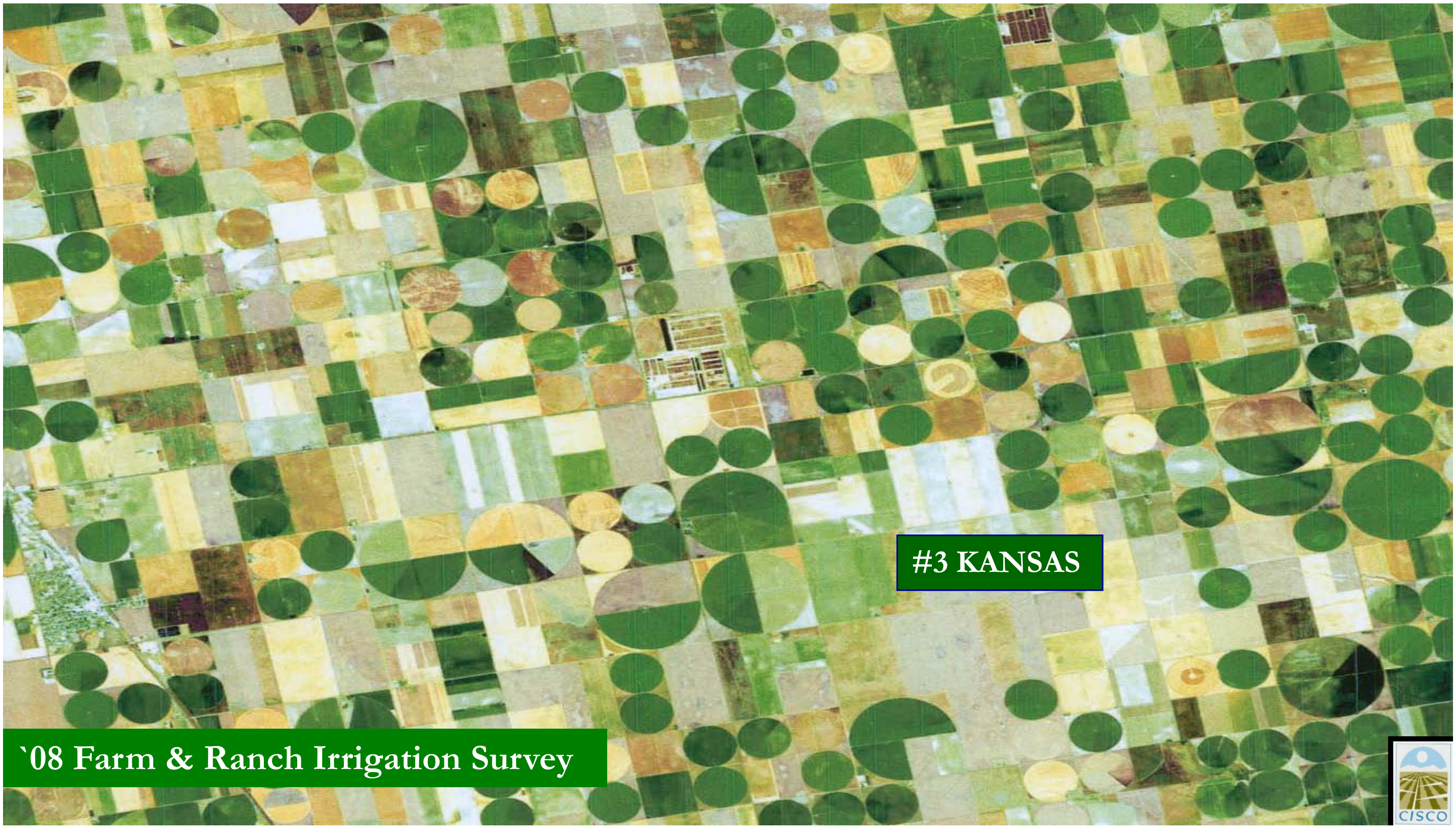
USDA NASS 2008

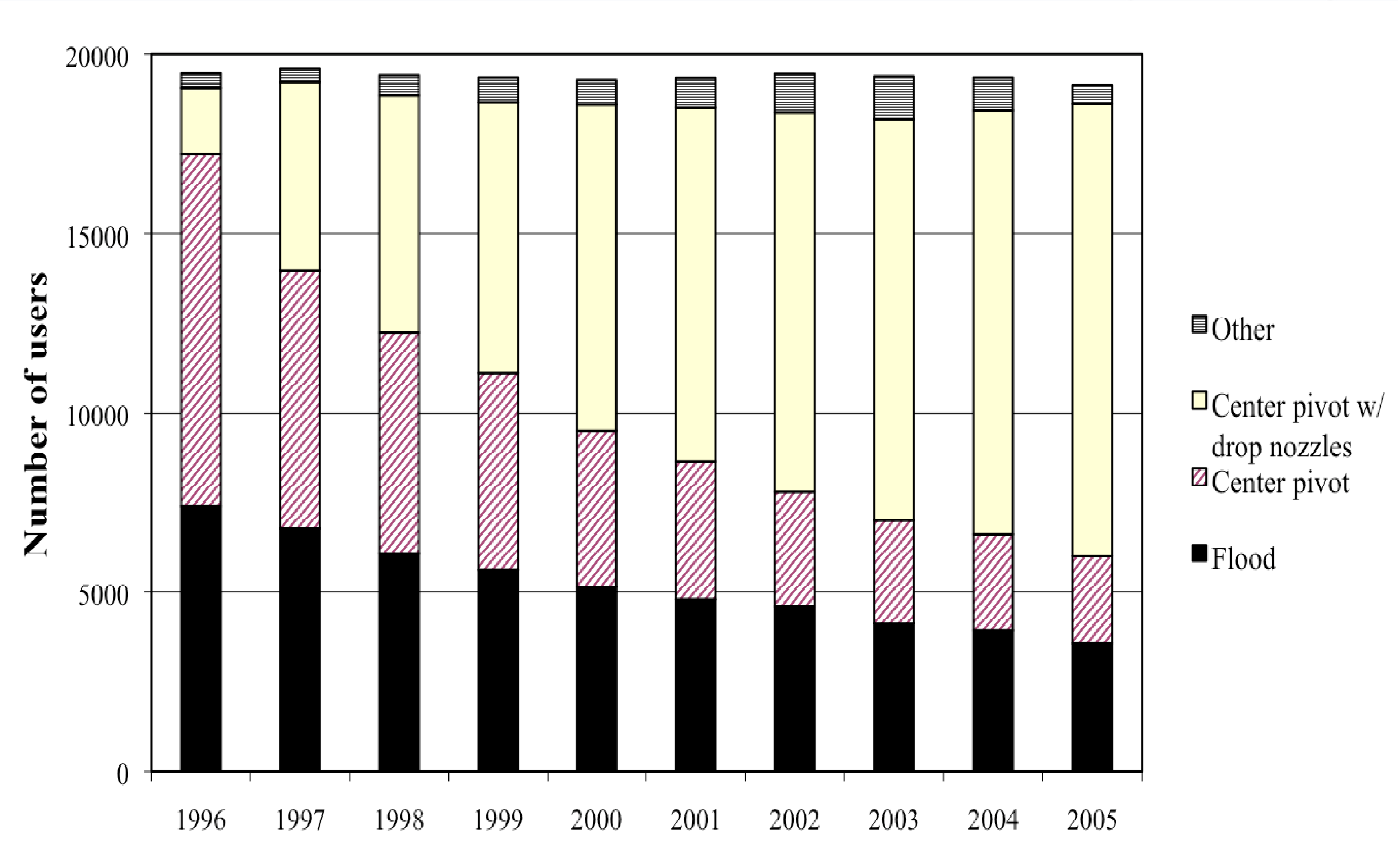
US Center Pivot Systems 'TOP 15' *

***#1** Nebraska's 65,000 pivots systems on **6.5** Mil acres apply 0.8 foot/acre!*

#2 Texas **4.1**m Kansas **2.4**m Idaho**1.8**m Colorado **1.3**m: "TOTAL **22** Million (73%)"

#The next 10~ **5.7** million Wash., .87m Georgia .82m Ark, .78m Montana .58 Min Oregon .53m, .47Missouri .46 Illinois 45 Miss, .38 Ind. .38





Recent changes in irrigation practices in Nebraska

Pfeiffer and Lin, 2009


John Diener
Five Points, CA

Darrell and Trevor Cordova
Denair, CA

Irrigation technology grows, water costs rise

Aug 11, 2009 11:05 AM, By Harry Cline, Farm Press Editorial Staff

Kenny Marsh excused himself for a few minutes before driving around the 12,000-acre Triangle T Ranch in Chowchilla, Calif., to be interviewed about the 27 center pivot irrigation systems that have been installed on the diversified farming and livestock operation.

KENNY MARSH manages 27 center pivot irrigation systems like the one behind him at the Triangle T Ranch in Chowchilla, Calif.

He was busy working with a ranch office staffer in entering information in a database he custom-designed for the 63 active irrigation wells on the farm.

Marsh is assistant manager of Triangle T where his father, Doug, a well known Madera County farmer, has been farm manager for many years.

Marsh grew up working on the farm before going into the Air Force where he became skilled with computers. After the service he augmented his military experience with computer classes from ITT Technical Institute. His resume also includes working several years as water master for the Chowchilla Irrigation District, a job experience he enhanced with irrigation courses at Cal Poly, San Luis Obispo.

At his desk in the ranch office are two large flat screen monitors connected to the ranch's computer network. A laptop computer sits on the edge of the desk. In his truck are a myriad of communication gadgets. One of the cup holders is occupied with a hand-held GPS unit.

Marsh is part of the new wave of agricultural technology that he says has grown "exponentially" in the past few years. There are three GPS towers on the Triangle T. Virtually all the farm's tractors are GPS-equipped.

All 63 pumps entered in to the database Marsh designed contain vital pump information like energy use, water output and pump test efficiency information — in addition to GPS coordinates for each pump location. Why? Pumps don't move.

TODAY'S MOST VIEWED ARTICLES

- Irrigation technology grows, water costs rise
- Citrus legislation targets psyllid, HLB
- Big price gap may alter almond variety choices

HEADLINES BY FEEDBURNER

TODAY'S TOP NEWS

- Clonal search yields new wine varietals
- SJV wine grape growing tips
- La Verne fruit fly quarantine

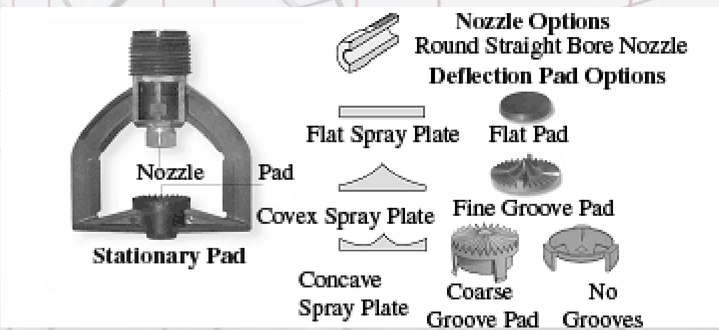
More Articles from this section


Pivots, pivots, pivots, everywhere
Five Points, CA 2008
Achieving even greater efficiencies by merging overhead irrigation with conservation tillage….?

ECONOMICS

Pivots Reduce Labor Costs

- Can Approach 90%
  - Modern Pivots
  - Automation Equip.
- Higher Skill Levels
  - Repair
  - Maintenance
  - Operation
- Future Labor Shortages



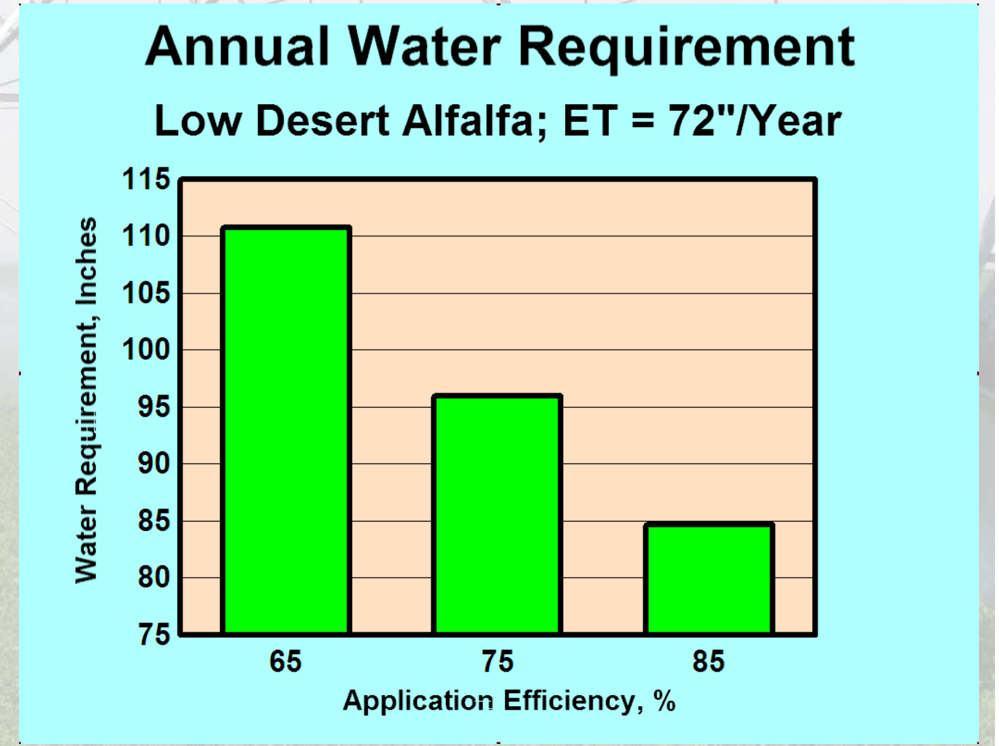
Source: Kranz & Martin, 2005

Adapted from Brown, 2008

WATER REQUIREMENT

Impact of Application Efficiency

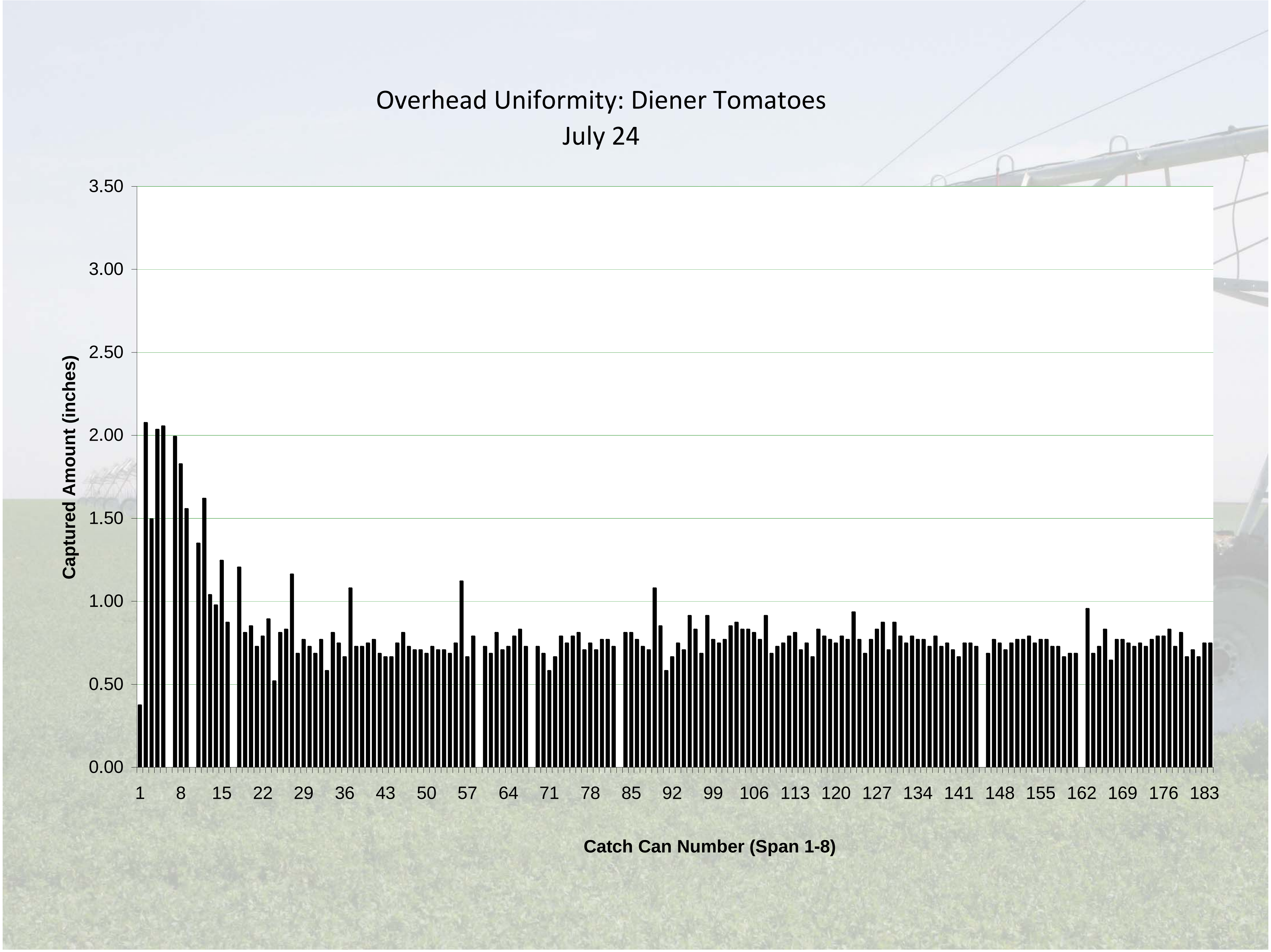
- Higher App. Efficiency
  - Reduces Water Requirements
  - AE Increase From 65-85%
    - Lowers WR 24% or ~26”/Yr
  - AE Increase From 75-85%
    - Lowers WR 13% or ~12”/Yr
  - Less Drainage/Runoff



Higher AE of Pivots Should Reduce Water Use By 10-30%

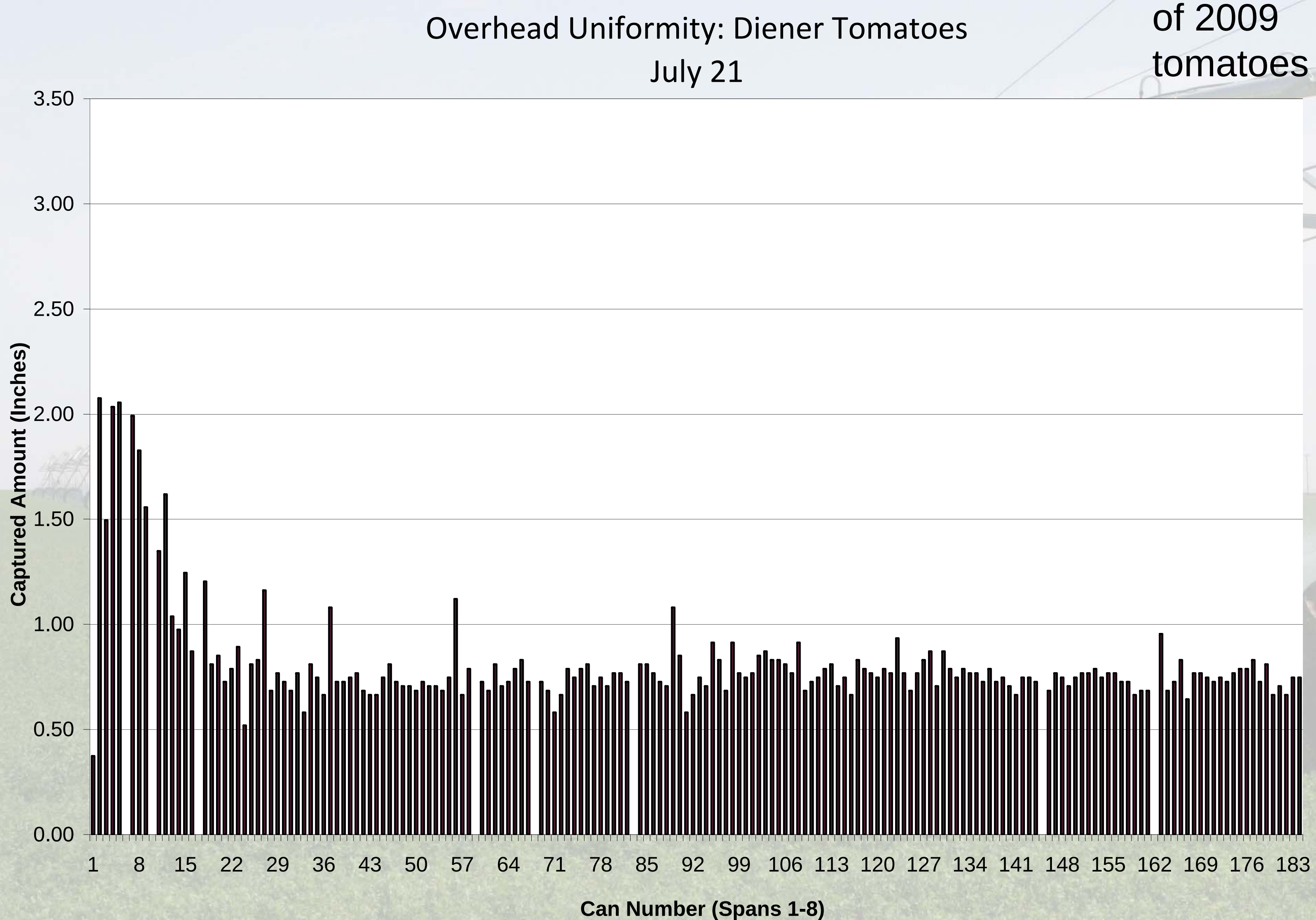
Adapted from Brown, 2008

Overhead irrigated processing tomatoes –
A commercial effort in Five Points, CA, 2009

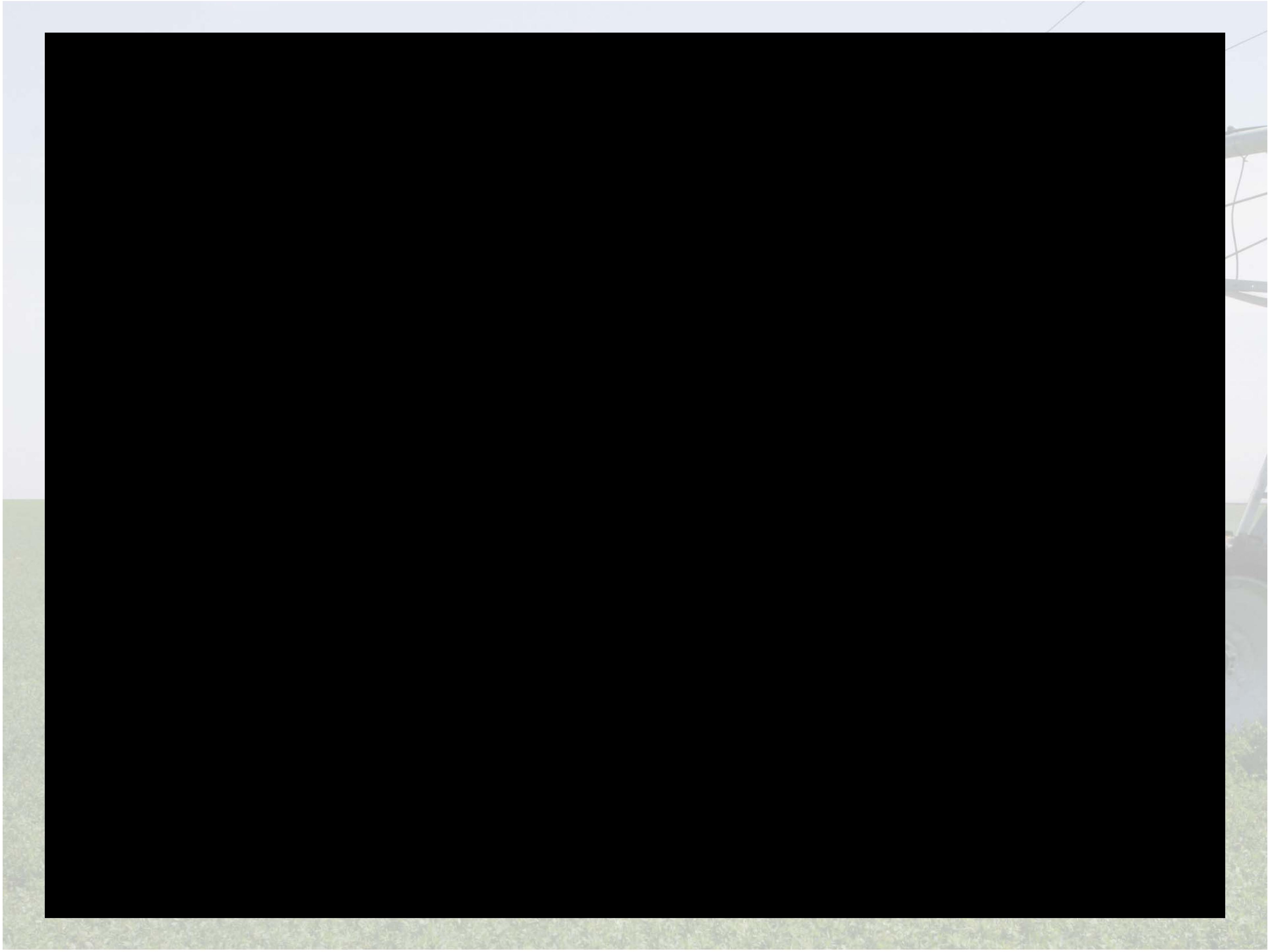


Overhead Uniformity: Diener Tomatoes
July 24
Captured Amount (inches)
3.50
3.00
2.50
2.00
1.50
1.00
0.50
0.00
1
8
15
22
29
36
43
50
57
64
71
78
85
92
99
106
113
120
127
134
141
148
155
162
169
176
183
Catch Can Number (Span 1-8)

Yield patterns of 2009 tomatoes



[redacted]

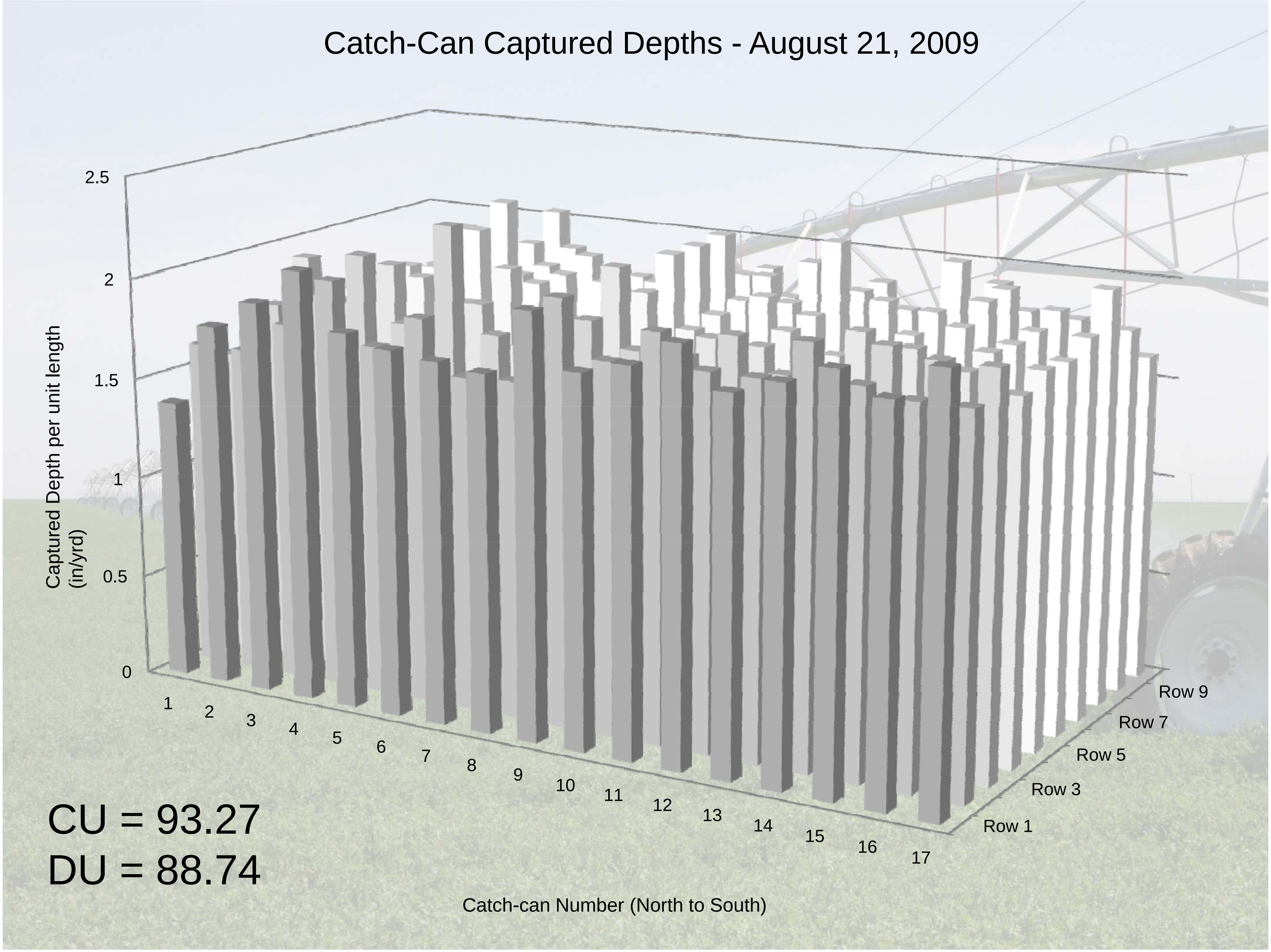



OUTLET

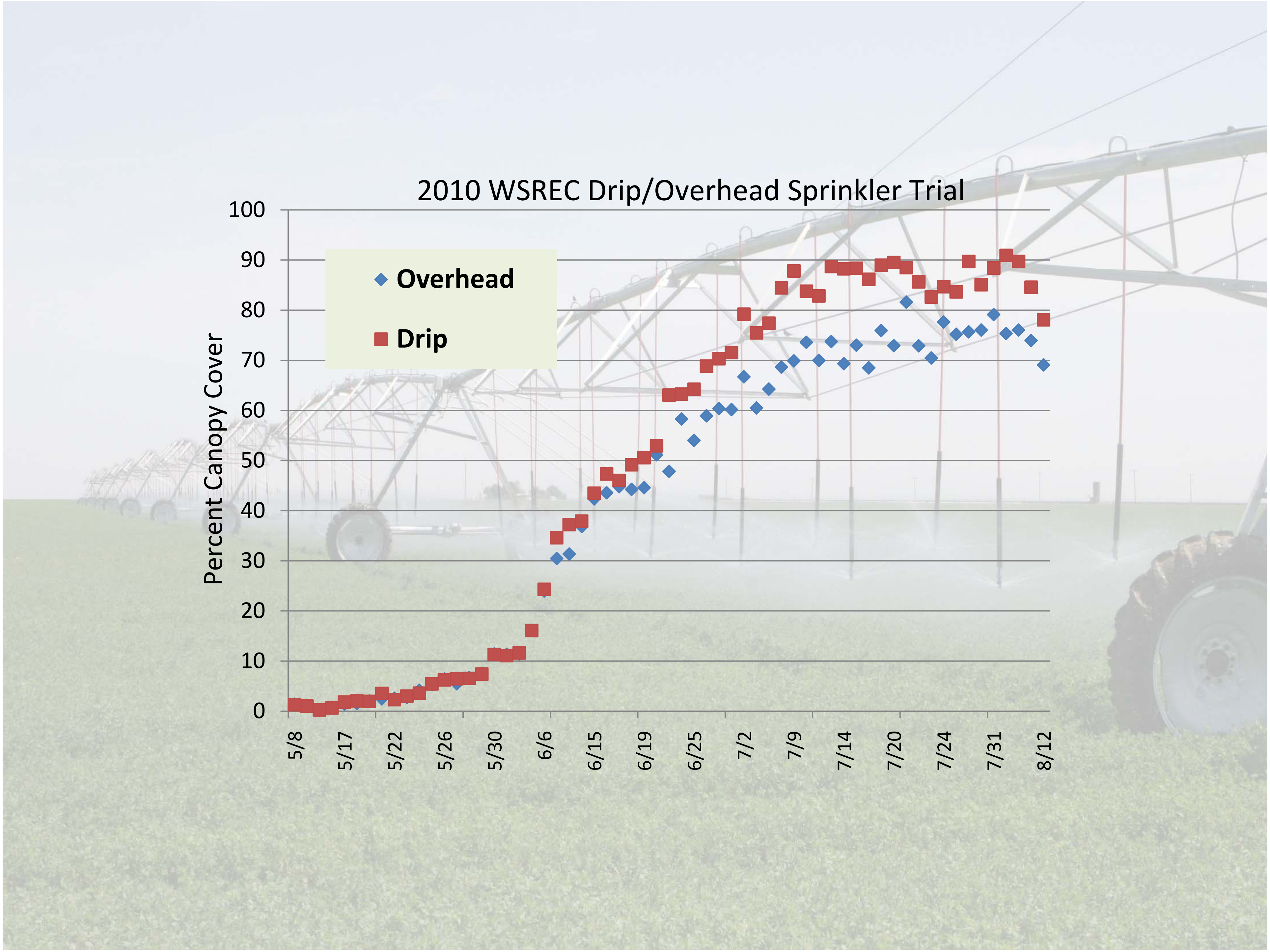
[redacted]

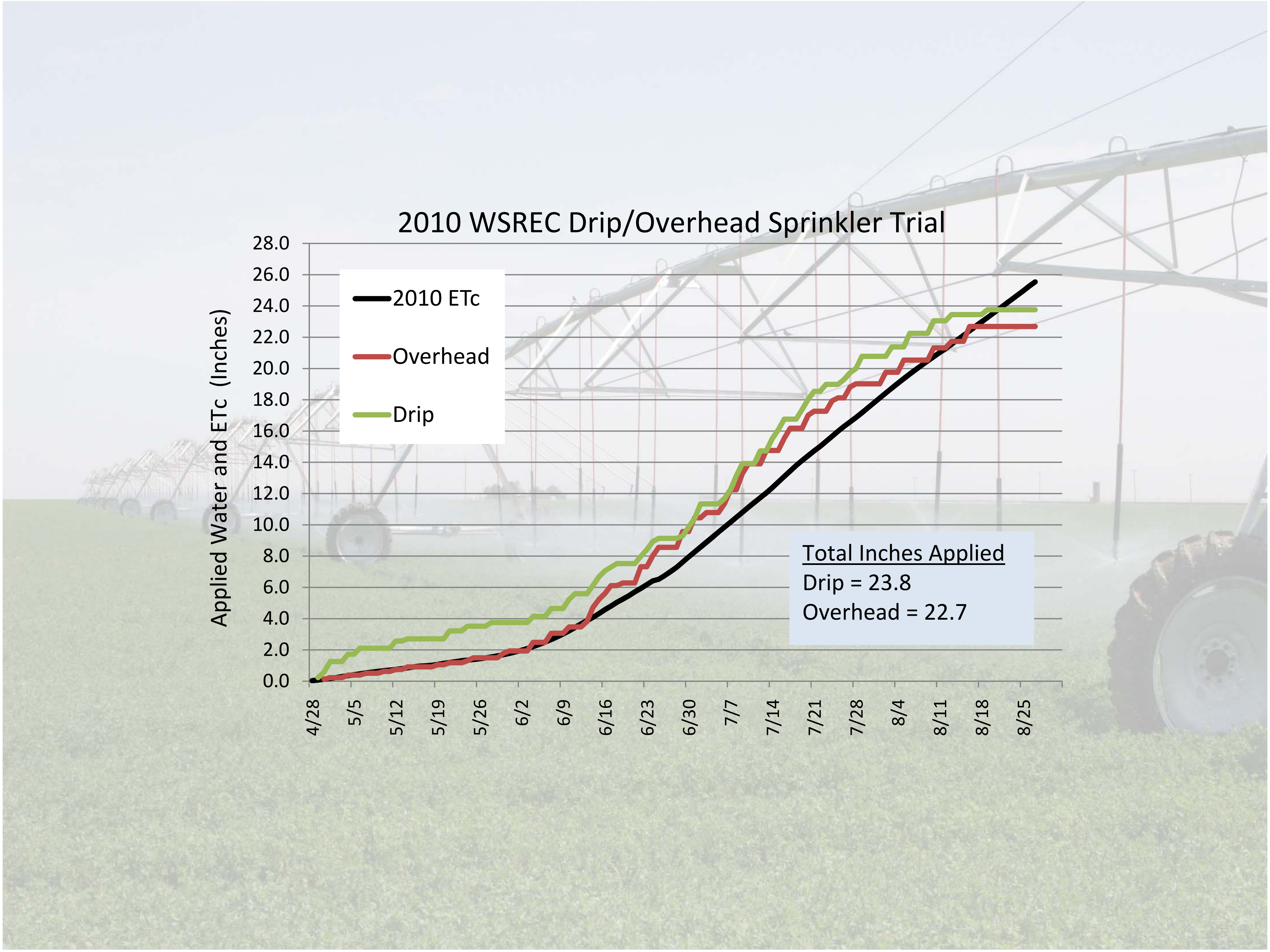
[redacted]

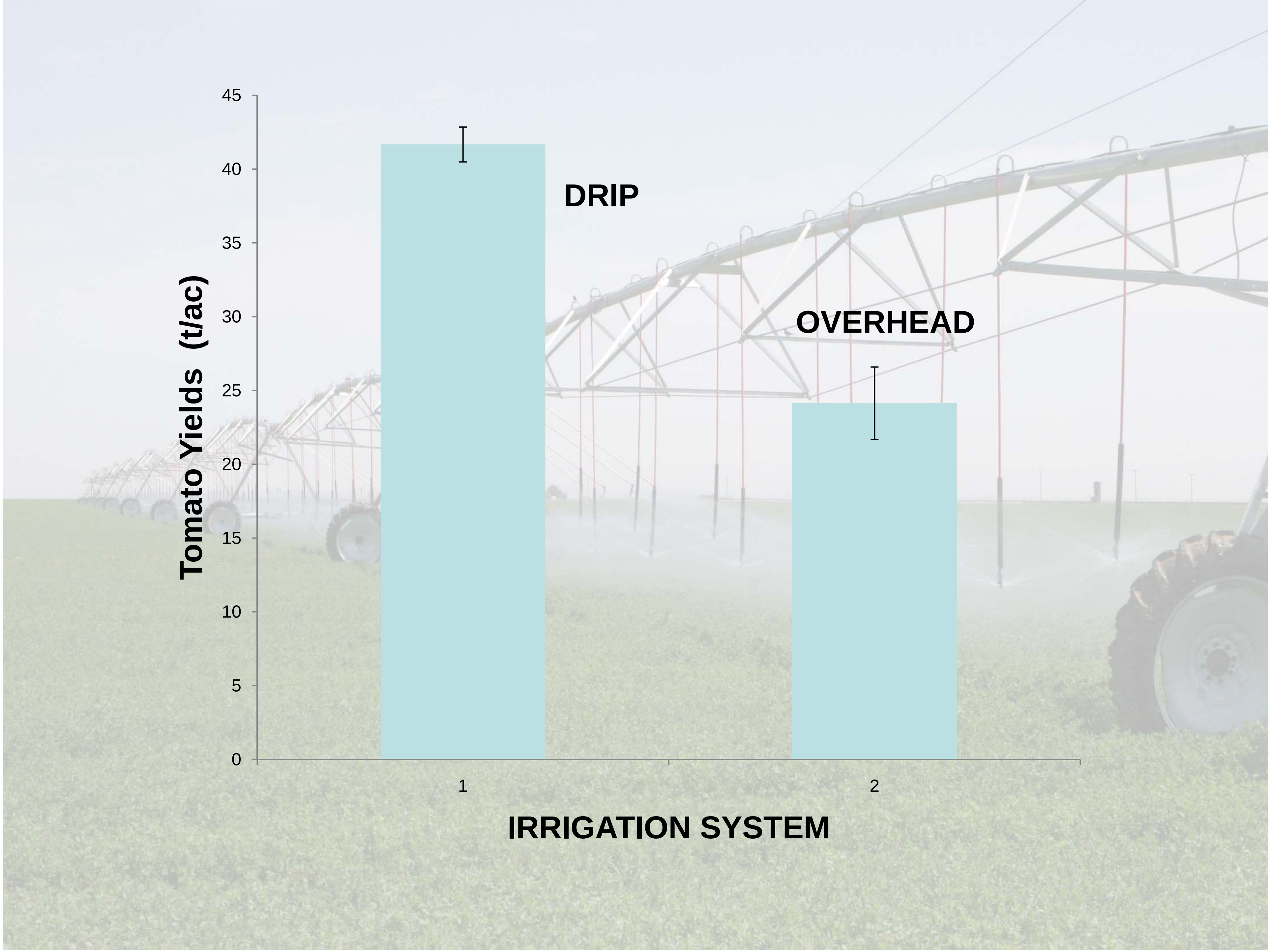

VALLEY



Catch-Can Captured Depths - August 21, 2009
Captured Depth per unit length (in/yrd)
0
0.5
1
1.5
2
2.5
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17
Row 1
Row 3
Row 5
Row 7
Row 9
Catch-can Number (North to South)
CU = 93.27
DU = 88.74


2010 WSREC Drip/Overhead Sprinkler Trial
Overhead
Drip
Percent Canopy Cover
100
90
80
70
60
50
40
30
20
10
0
5/8
5/17
5/22
5/26
5/30
6/6
6/15
6/19
6/25
7/2
7/9
7/14
7/20
7/24
7/31
8/12


2010 WSREC Drip/Overhead Sprinkler Trial
Applied Water and ETc (Inches)
28.0
26.0
24.0
22.0
20.0
18.0
16.0
14.0
12.0
10.0
8.0
6.0
4.0
2.0
0.0
4/28
5/5
5/12
5/19
5/26
6/2
6/9
6/16
6/23
6/30
7/7
7/14
7/21
7/28
8/4
8/11
8/18
8/25
2010 ETc
Overhead
Drip
Total Inches Applied
Drip = 23.8
Overhead = 22.7

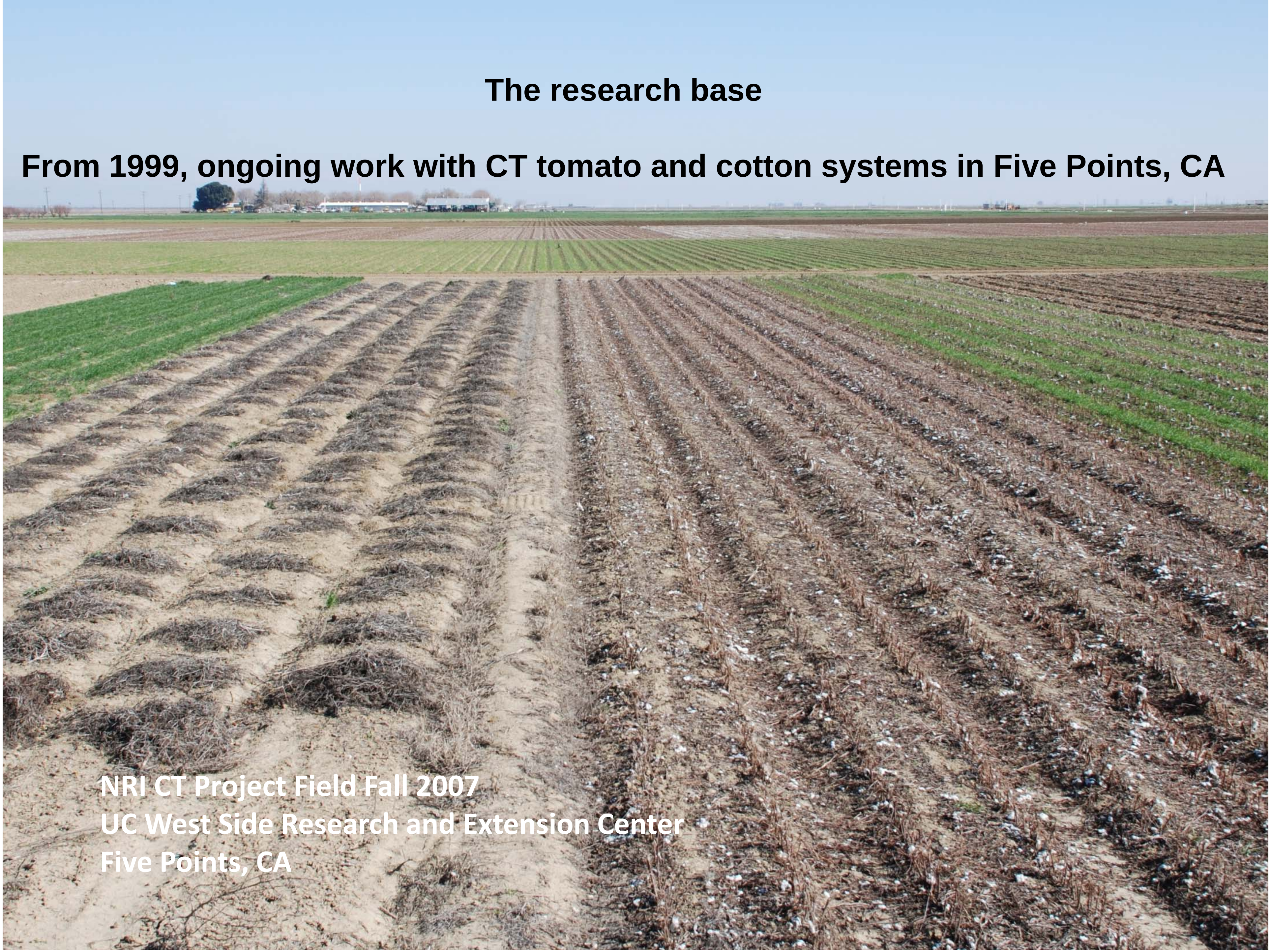


Tomato Yields (t/ac)
45
40
35
30
25
20
15
10
5
0
DRIP
OVERHEAD
1
2
IRRIGATION SYSTEM

Local TV news documentary crew interviewing farmers and overhead equipment company representatives in Five Points, CA, July 2010

The research base

From 1999, ongoing work with CT tomato and cotton systems in Five Points, CA

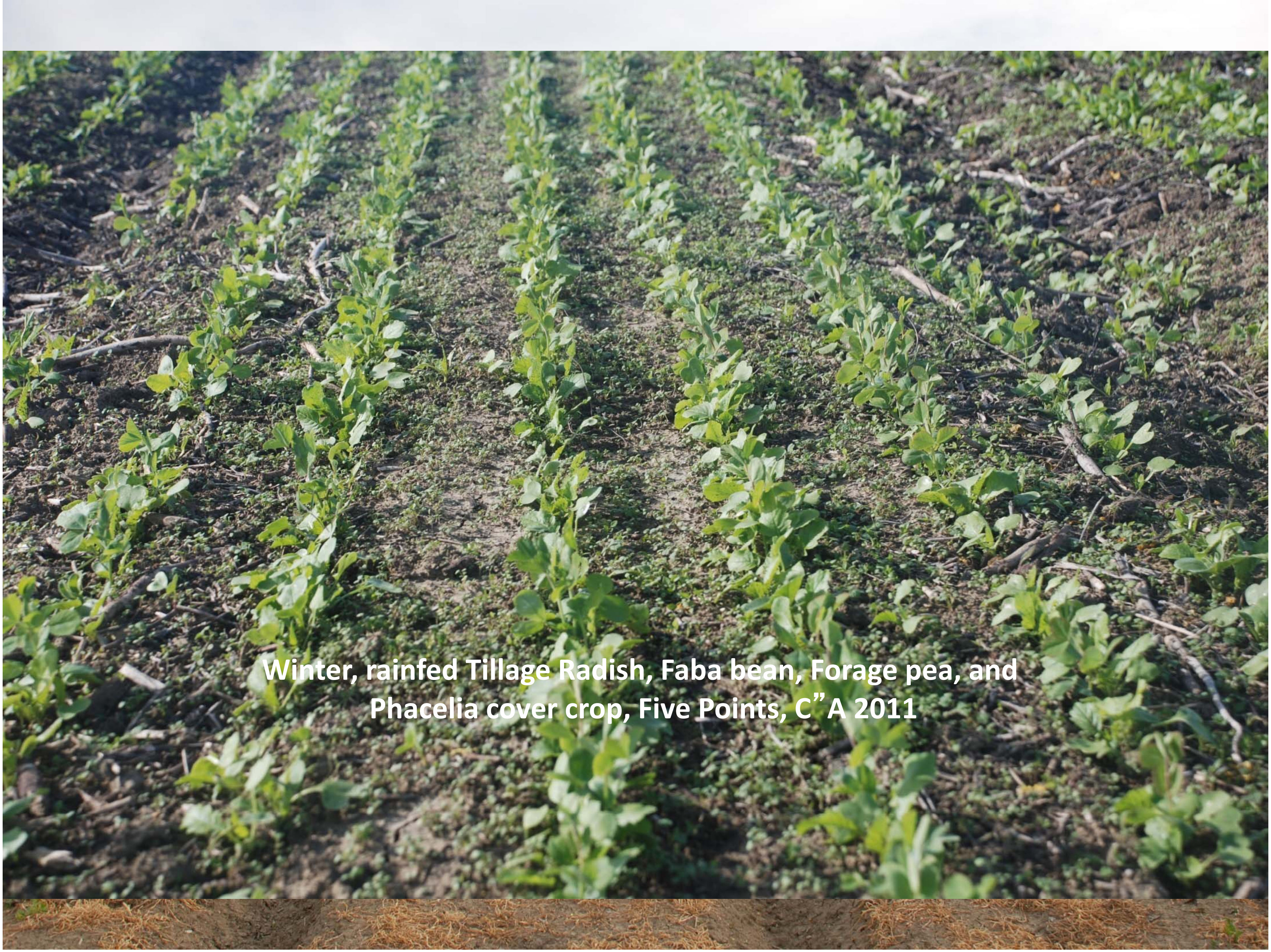


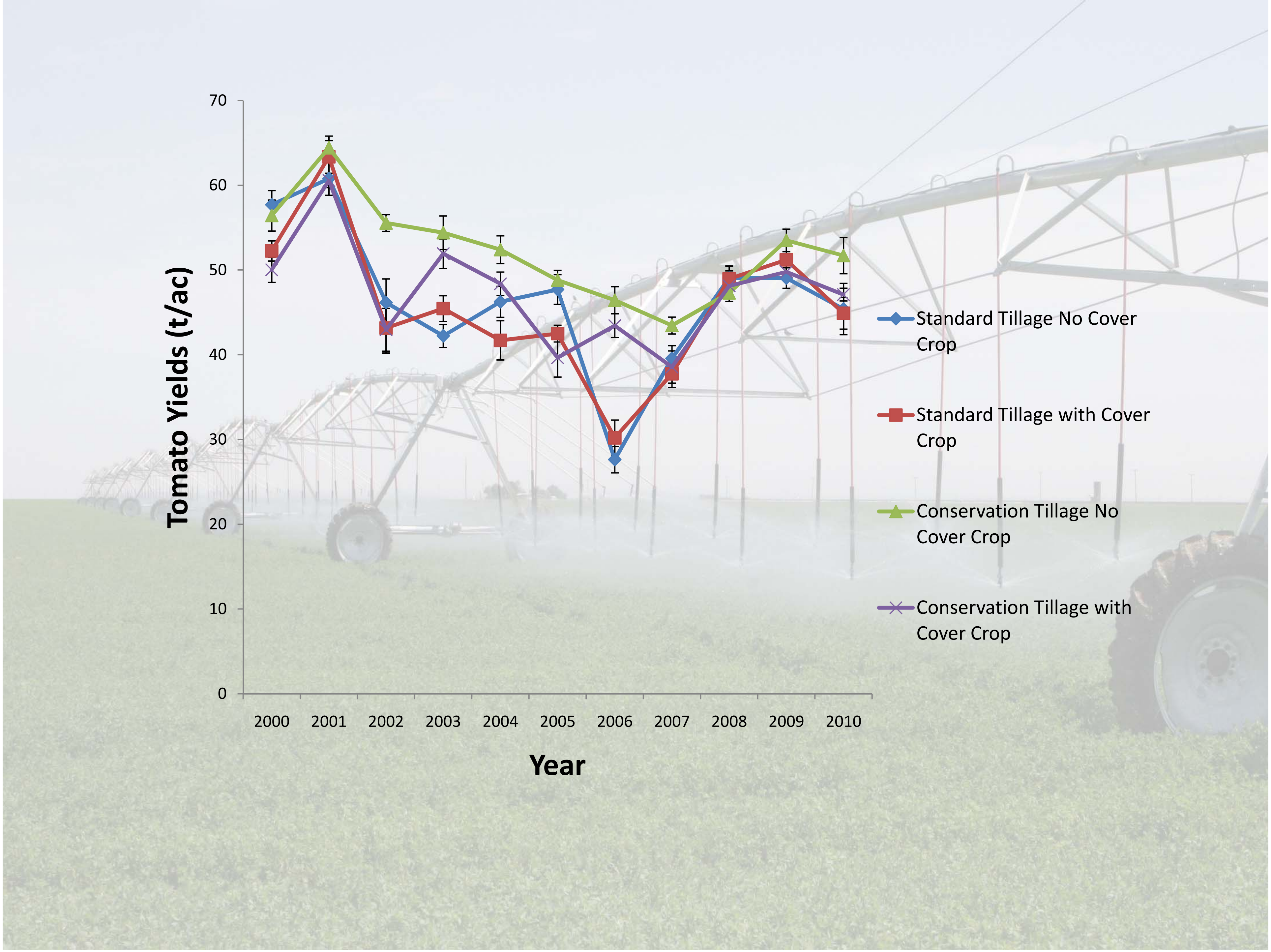
NRI CT Project Field Fall 2007
UC West Side Research and Extension Center
Five Points, CA

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


Winter, rainfed triticale, rye and pea cover crop no-till seeded into cotton and tomato residues
Five Points, CA 2008


Winter, rainfed Tillage Radish, Faba bean, Forage pea, and
Phacelia cover crop, Five Points, C”A 2011



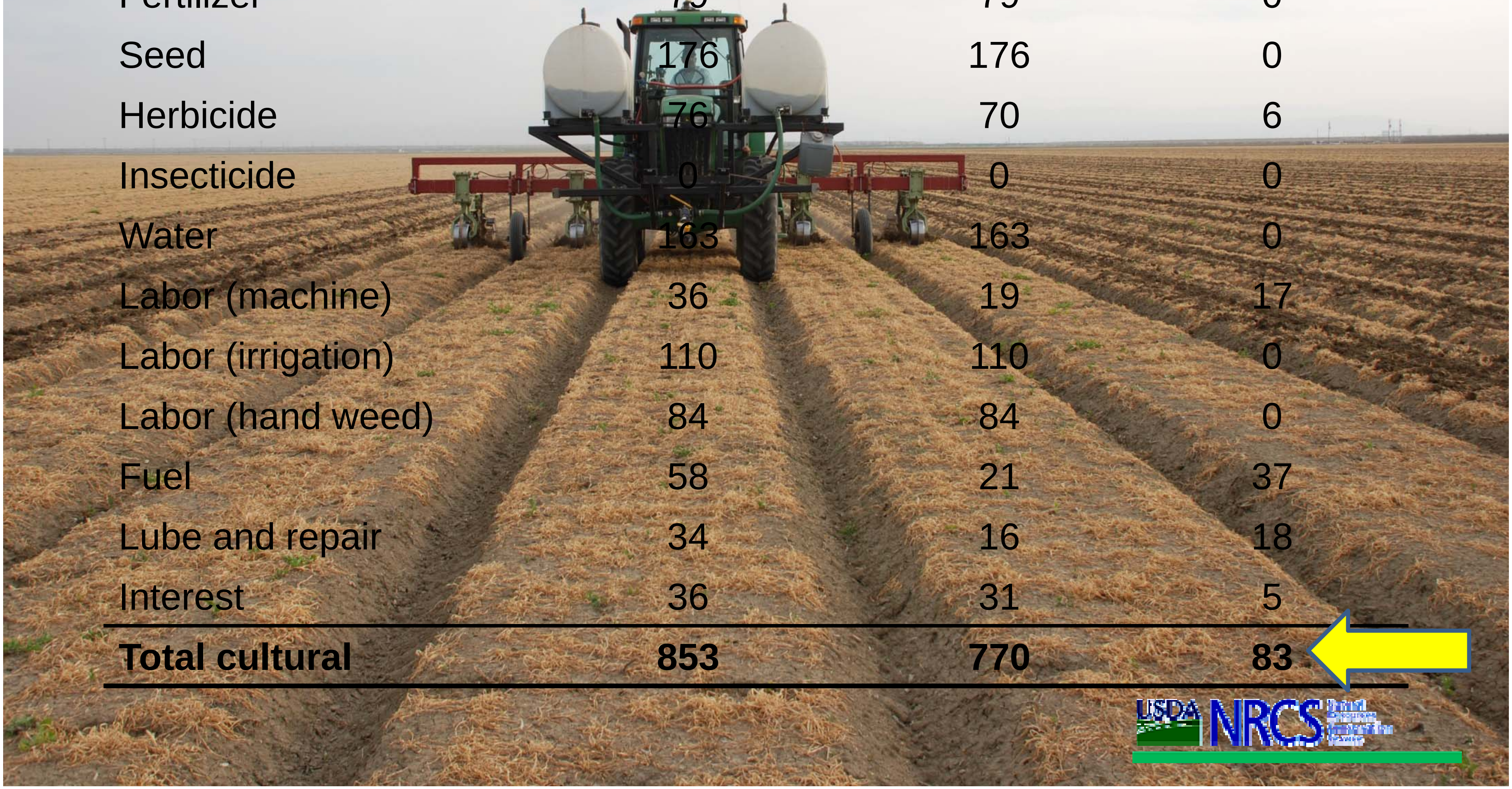
Tomato Yields (t/ac)
70
60
50
40
30
20
10
0
2000
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010
Year
Standard Tillage No Cover Crop
Standard Tillage with Cover Crop
Conservation Tillage No Cover Crop
Conservation Tillage with Cover Crop

Tillage and cover crop system erosion estimates, soil condition index sub-factors, soil tillage intensity rating and estimates of diesel fuel use.

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

* 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)



Cultural costs	ST	CT	Difference (ST-CT)
Fertilizer	79	79	0
Seed	176	176	0
Herbicide	76	70	6
Insecticide	0	0	0
Water	163	163	0
Labor (machine)	36	19	17
Labor (irrigation)	110	110	0
Labor (hand weed)	84	84	0
Fuel	58	21	37
Lube and repair	34	16	18
Interest	36	31	5
Total cultural	**853**	**770**	**83**

Soil Carbon weights (t/ha)

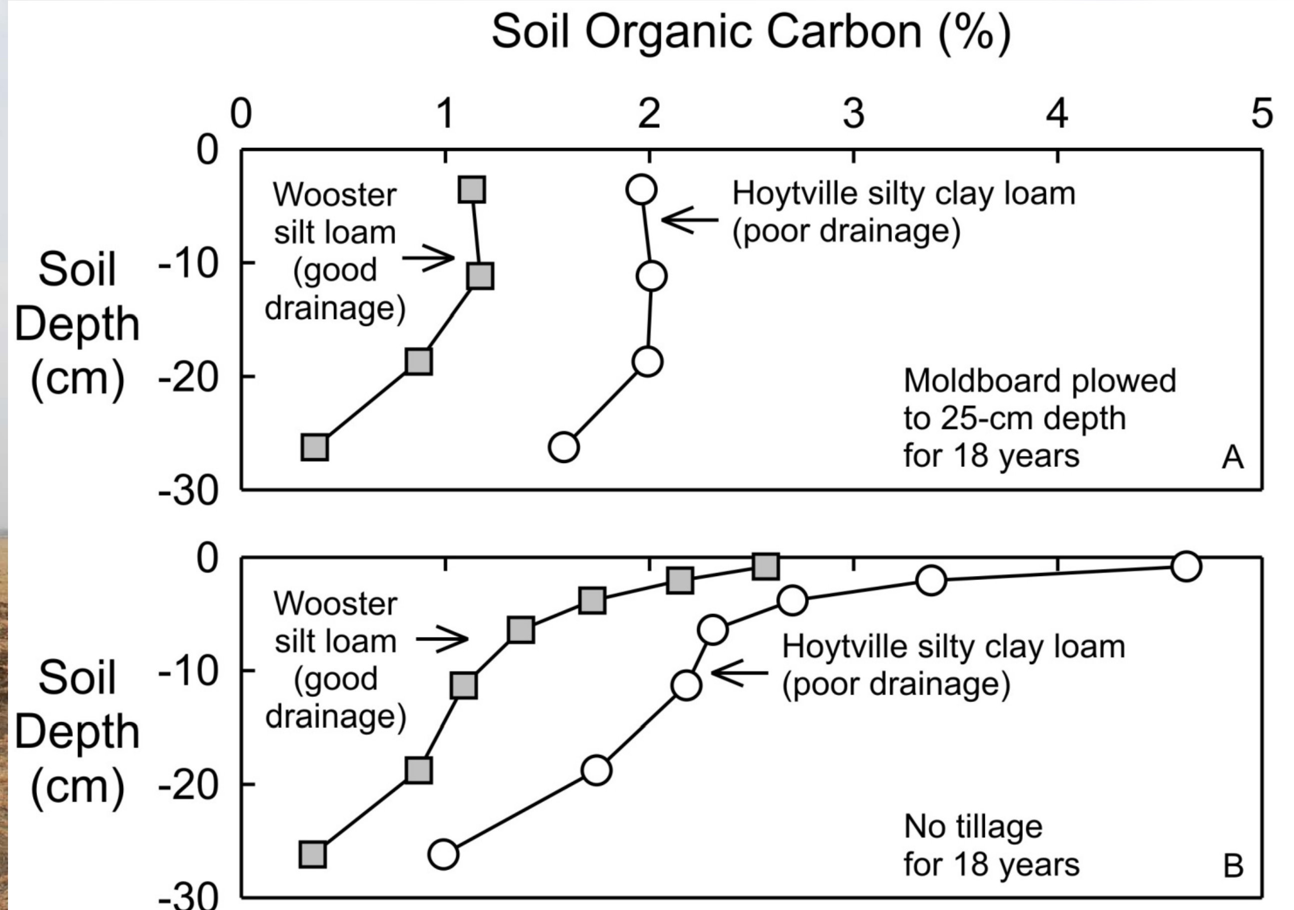
Depth (cm)	Standard Till No Cvr Crop	Standard Till Winter Cvr Crop	Conservation Tillage No Cvr Crop	Conservation Tillage Winter Cvr Crop
0-15	10.74 (0.26)	13.68 (0.43)	14.51 (0.61)	15.95 (3.43)
15-30	11.59 (0.43)	13.69 (0.73)	11.69 (0.45)	12.89 (0.54)
Total	22.33 C	27.37 B	26.20 B	28.84 A

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.

No-till cotton production following tomato
Five Points, CA • 2000 - 2010

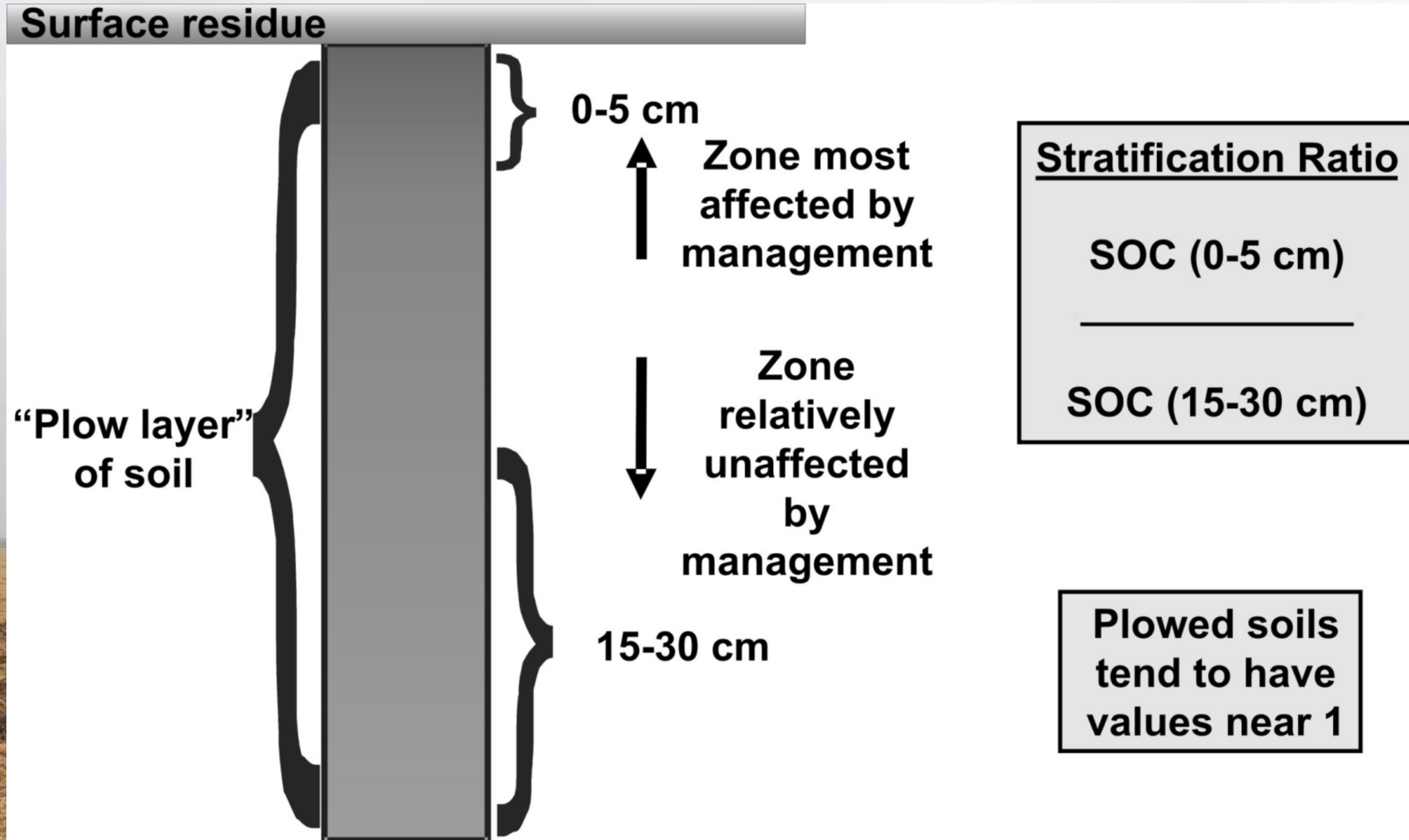
Conservation Tillage Workgroup

ANR University of California · UCCE · UC Davis Plant Sciences · UC Davis College of Agricultural & Environmental Sciences · NRCS · Sustainable Conservation · Resource Conservation Districts · American Farmland Trust



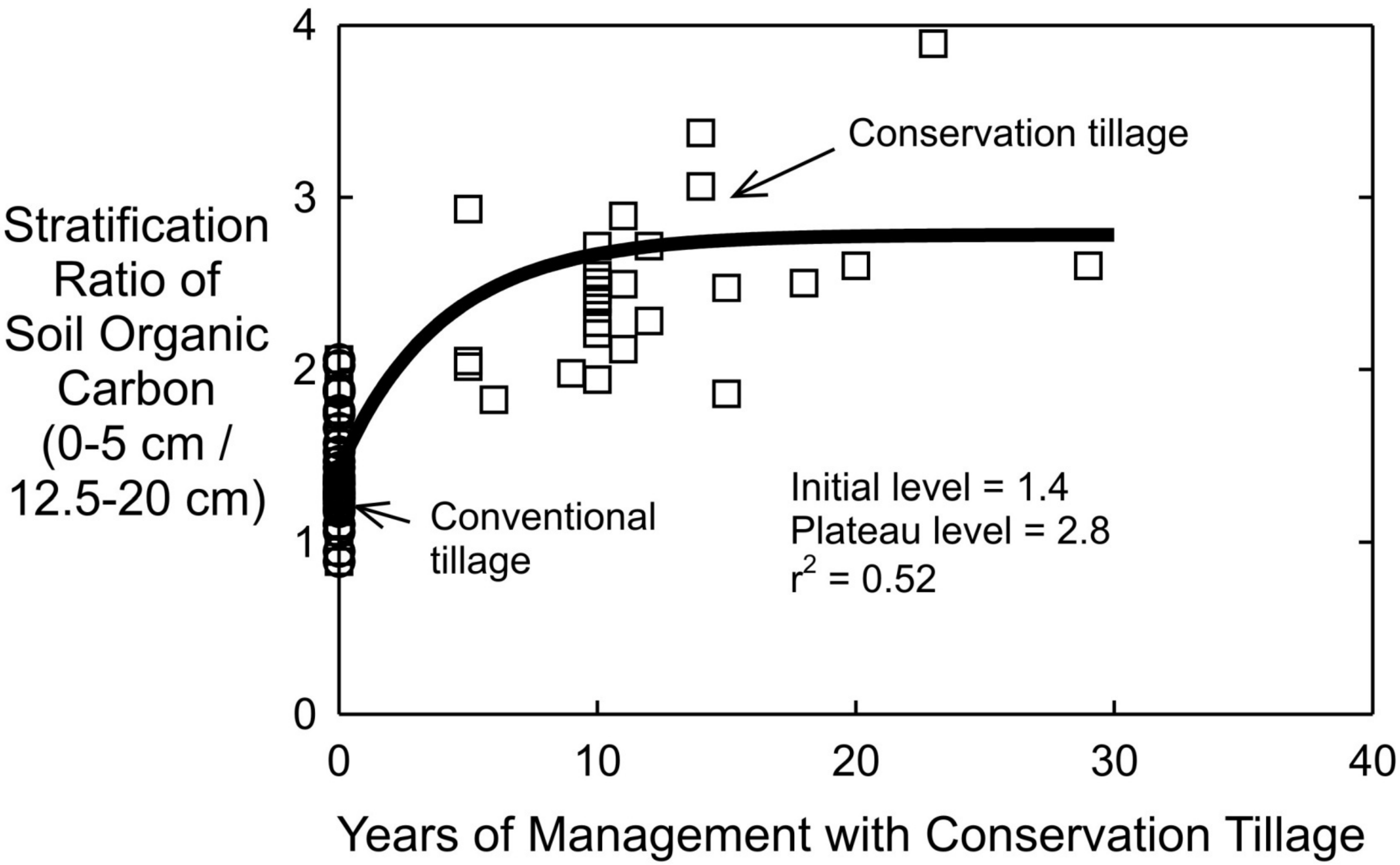
Organic carbon under conventional tillage (A) and under no tillage (B) in two contrasting soils in Ohio. Data from Dick WA (1983) Soil Sci. Soc. Am. J. 47:102-107.

Presented in Franzluebbers AJ. Surface soil organic matter as an indicator of soil quality, Winter Issue No. 58, 2010 Prairie Steward – Farming for Your Future Environment, the Newsletter of the Saskatchewan Soil Conservation Association Inc.



Conceptual diagram for the calculation of stratification ratio of soil organic matter.

Presented in Franzluebbers AJ. Surface soil organic matter as an indicator of soil quality, Winter Issue No. 58, 2010 Prairie Steward – Farming for Your Future Environment, the Newsletter of the Saskatchewan Soil Conservation Association Inc.



Changes in stratification ratio of soil organic carbon with time under conservation-tillage management in a survey of 89 farms in the southeastern USA.
Data from Causarano HJ, Franzluebbers AJ, Shaw JN, Reeves DW, Raper RL, Wood CW (2008) Soil Sci. Soc. Am. J. 72:221-230.

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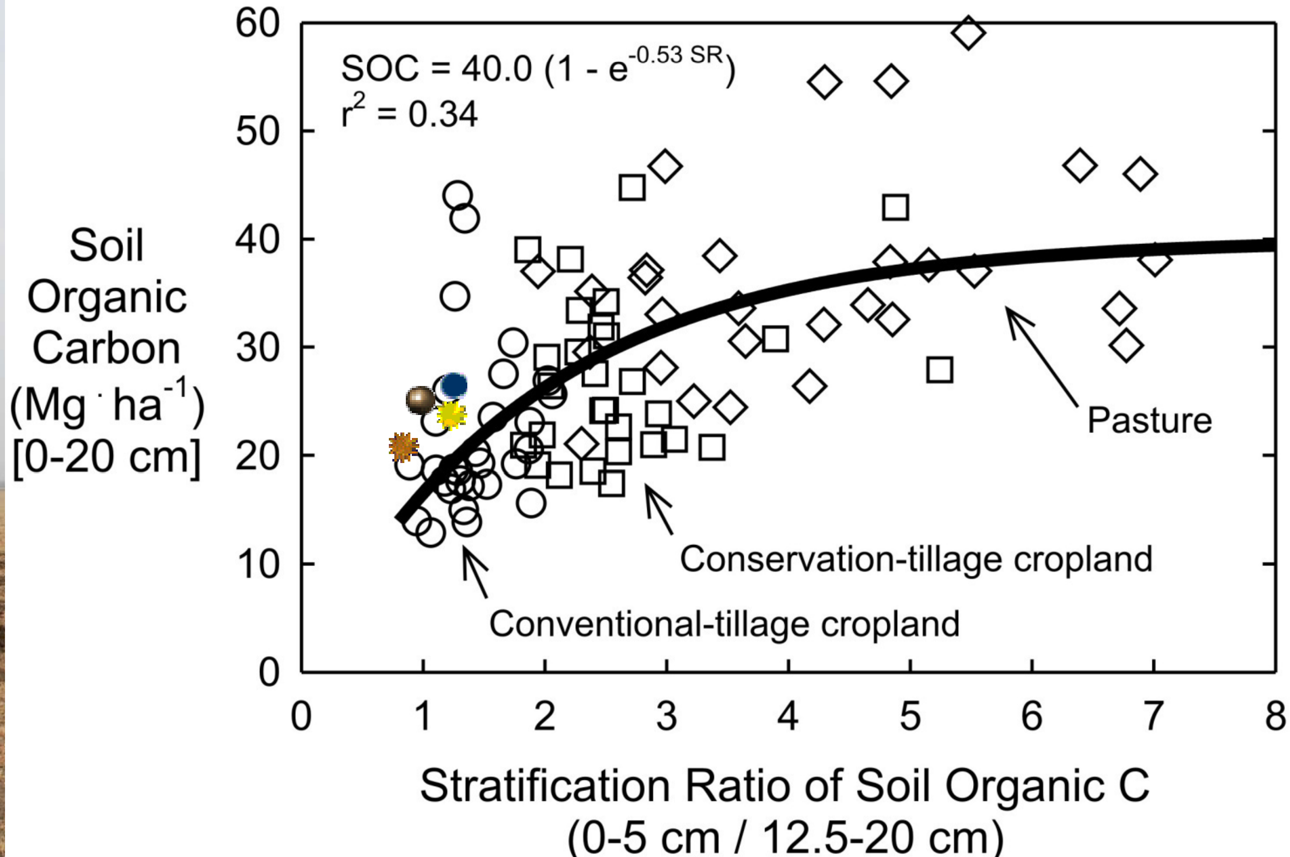
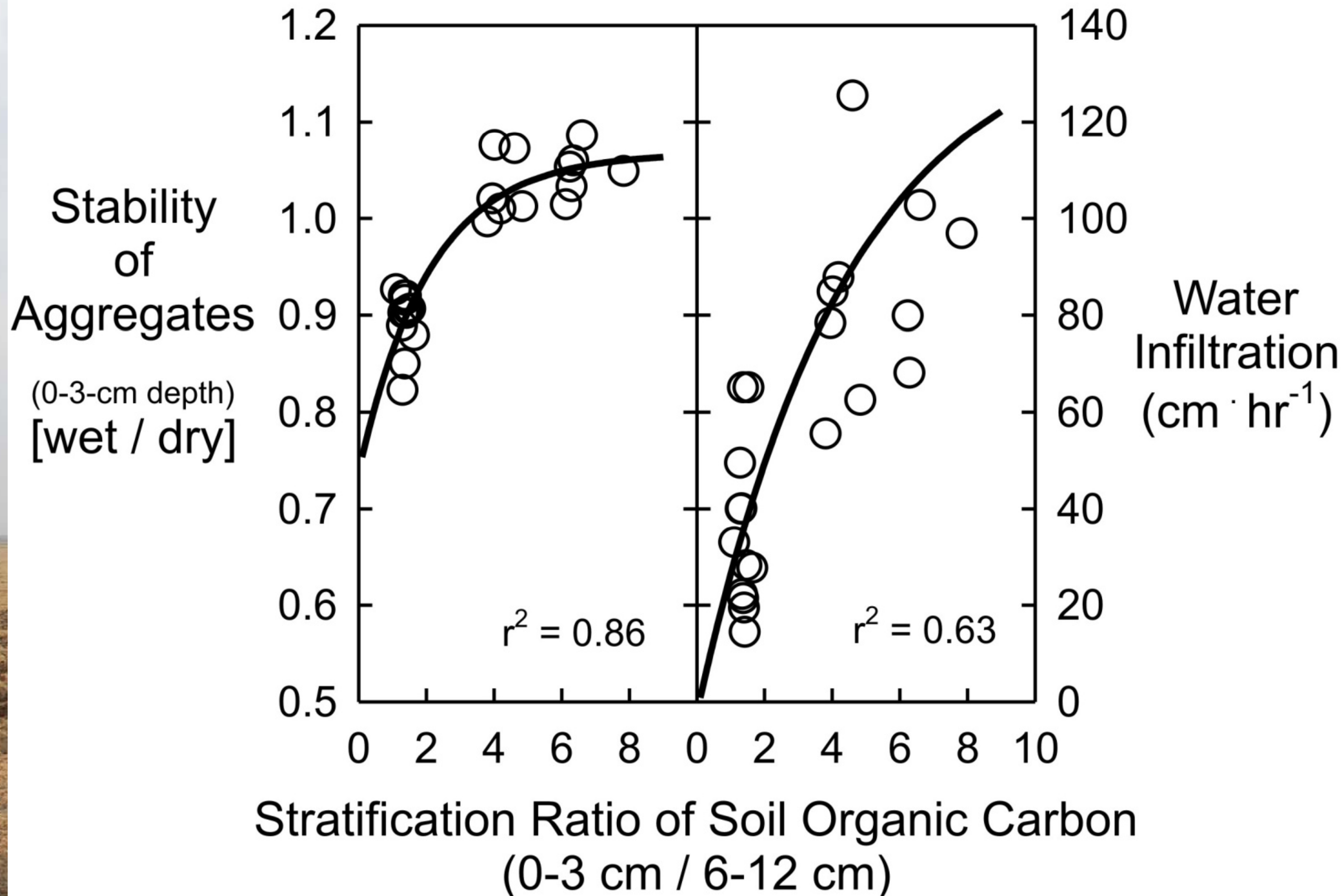


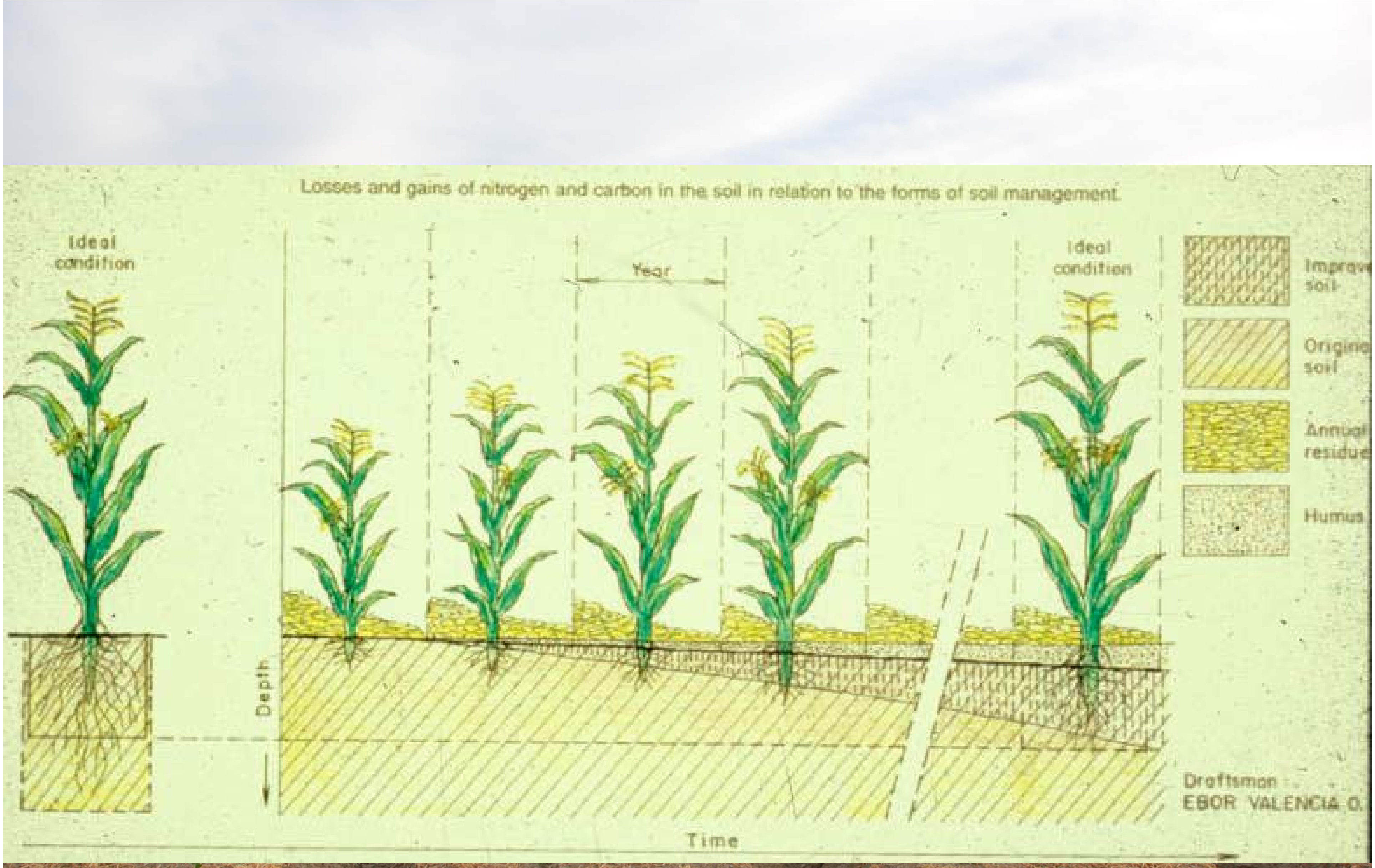
Stock of soil organic carbon to a depth of 20 cm in relation to the stratification ratio of soil organic carbon from a survey of 89 farms throughout the southeastern USA.
Data from Causarano HJ, Franzluebbers AJ, Shaw JN, Reeves DW, Raper RL, Wood CW (2008) Soil Sci. Soc. Am. J. 72:221-230.

Presented in Franzluebbers AJ. Surface soil organic matter as an indicator of soil quality, Winter Issue No. 58, 2010 Prairie Steward – Farming for Your Future Environment, the Newsletter of the Saskatchewan Soil Conservation Association Inc.



Relationship of water-stable aggregation and water infiltration to the stratification ratio of soil organic carbon in soils from Georgia.
Data from Franzluebbers AJ (2002) Soil Tillage Res. 66:197-205.

Presented in Franzluebbers AJ. Surface soil organic matter as an indicator of soil quality, Winter Issue No. 58, 2010 Prairie Steward – Farming for Your Future Environment, the Newsletter of the Saskatchewan Soil Conservation Association Inc.



Stubble Over the Soil
Carlos Crovetto
1996


CATERPILLAR
CAT


San Pacific Farms
Firebaugh, CA
Sano Farm
Firebaugh, CA
Strip-till tomatoes into winter cover crops
Conservation Tillage Workgroup
Sustainable Conservation
NRCS
RESOURCE CONSERVATION DISTRICTS
American Farmland Trus
UC DAVIS PLANT SCIENCES
UC DAVIS COLLEGE OF AGRICULTURAL & ENVIRONMENTAL SCIENCES
ANR UNIVERSITY of CALIFORNIA
UCCE

Scaling up

**Commercialization of these practices
at Sano Farms and Sun Pacific
since 2004**

Fall tillage using Wilcox 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


“Scaling up” conservation tillage techniques
at commercial processing tomato farm
Firebaugh, CA
2008

Typical burned down cover crop following strip-tilling


Strip-till planted processing tomatoes
Firebaugh, CA 2006

Costs by Item Table

Operation	Standard	Intermediate	Sano
Machine Labor Hours	2.21	1.28	0.67
Machine Labor Costs	30.32	17.49	9.18
Non-Machine Labor Hours	0.00	0.00	1.00
Non-Machine Labor Costs	0.00	0.00	10.96
Diesel Gallons	29.10	13.42	6.64
Diesel Costs	59.36	27.38	13.56
Lube	8.90	4.11	2.03
Repair	20.14	10.61	8.44
Interest	7.46	4.67	9.70
Total Operation Costs	126.18	64.26	53.87
Cash Overhead	2.49	1.44	1.78
Non Cash Overhead	27.51	15.44	17.89
Total Costs	156.18	81.14	73.54
Add Materials			
Water	81.25	81.25	81.25
Roundup	32.28	32.28	32.28
Cover Crop	0.00	0.00	28.00
Total Materials	113.53	113.53	141.53
Total Costs	269.71	194.67	215.07

Conservation Tillage Tomato Production at Sano Farm
Firebaugh, CA
Alan Sano and Jesse Sanchez

December 27, 2009

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Introduction

During the past six years, Sano Farm in Firebaugh, CA has refined a production system for processing tomatoes that uses cover crops, subsurface drip irrigation, and conservation tillage practices. The overall system that Alan Sano, the co-owner of Sano Farm, and Jesse Sanchez, the farm's manager, developed saves fuel by reducing the number of tractor operations that are

Sano Farm is a 4000-acre farm in the Westlands Water District of Western Fresno County. In past years, it produced a variety of crops including cotton, melons and tomatoes, however, during about the past four years, it exclusively produces processing tomatoes on its annual cropland.

Winter Cover Crops

University of California
Division of Agriculture and Natural Resources
http://anrcatalog.ucdavis.edu

UC PEER REVIEWED

Publication 8330 / January 2009

University of California Cooperative Extension

UC DAVIS PLANT SCIENCES

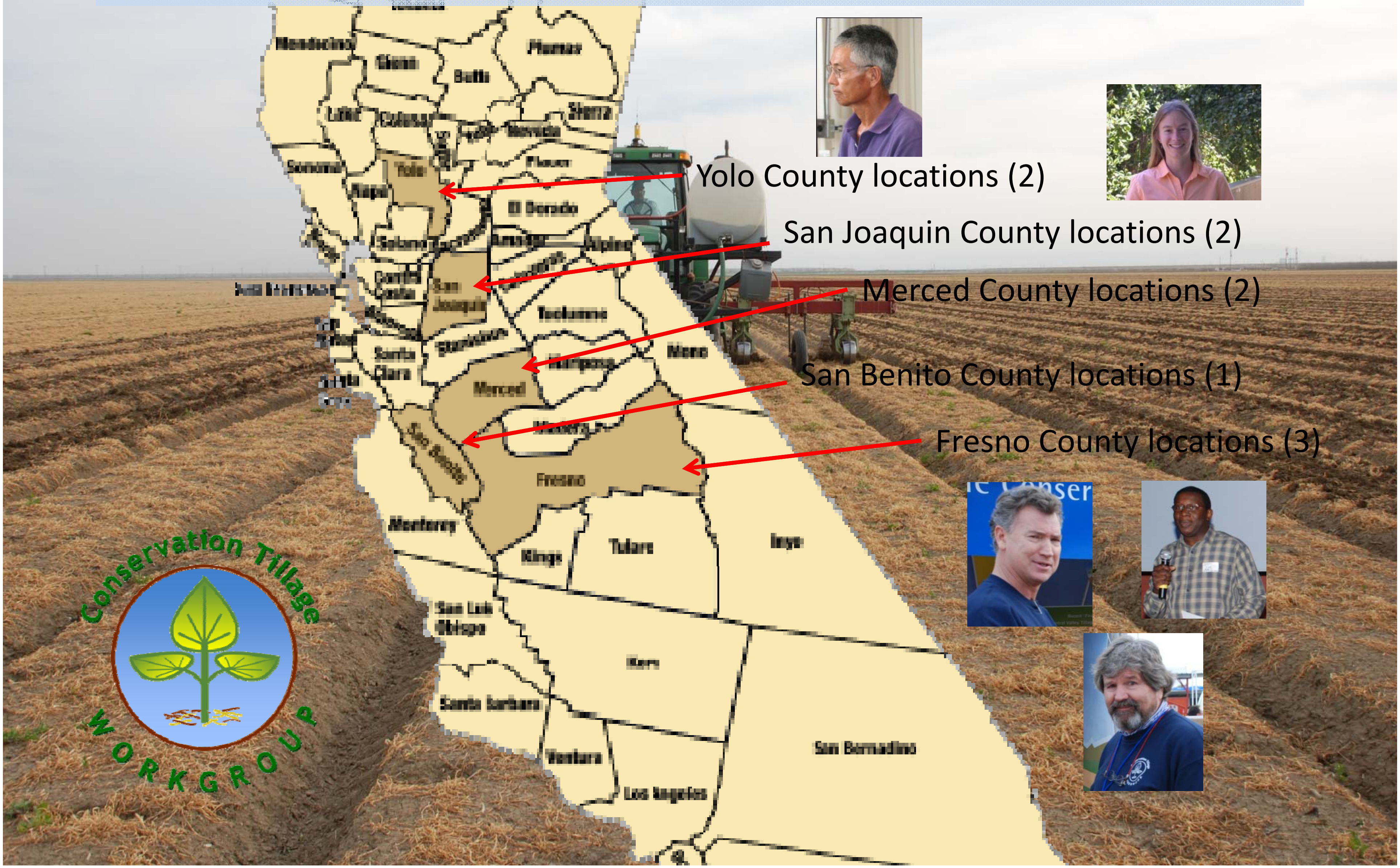
UC DAVIS COLLEGE OF AGRICULTURAL AND ENVIRONMENTAL SCIENCES

Conservation Tillage Tomato Production in California's San Joaquin Valley

J. P. MITCHELL, Department of Plant Sciences, University of California, Davis; **K. M. KLONSKY**, Department of Agricultural and Natural Resource Economics, University of California, Davis; **E. M. MIYAO**, University of California Cooperative Extension, Yolo, Solano, and Sacramento Counties; and **K. J. HEMBREE**, University of California Cooperative Extension, Fresno County.

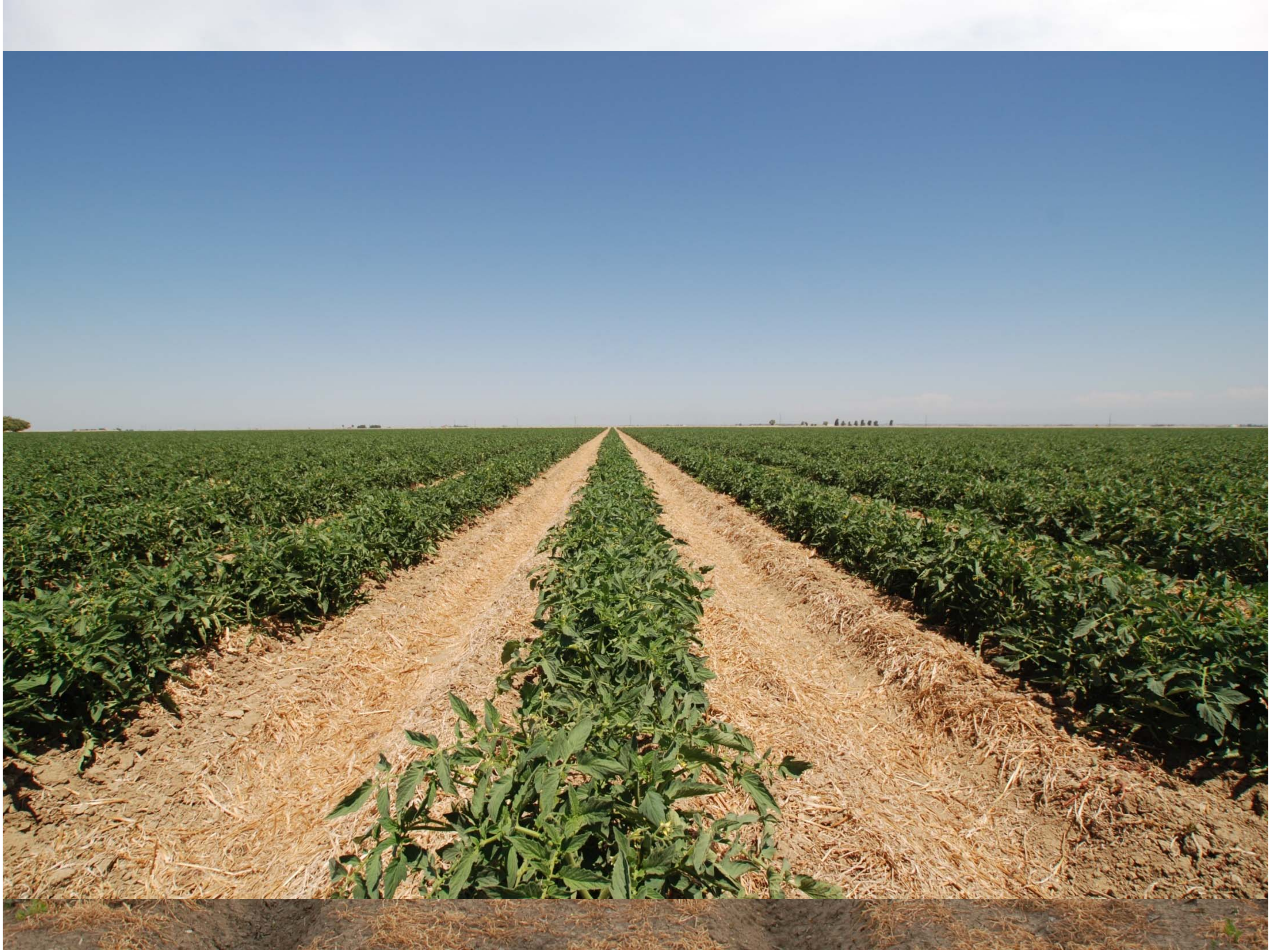
Rising fuel and labor costs and stagnant commodity prices encourage tomato growers to minimize production costs whenever possible. Reducing tillage in crop rotations typically associated with bed-preparation operations may be a means to cut costs in tomato production systems. During the past several decades, a wide range of crop production systems have been developed that minimize or eliminate tillage from crops such as corn, cotton, beans, and wheat (MWPS 2000). By reducing soil disturbance, these systems preserve surface residues, reduce soil erosion, conserve water, and may enable more diverse and intensive crop rotations in areas of limited rainfall. Collectively, these practices have been called conservation tillage (CT) systems. Historically they have been based on various production practices that maintain 30 percent or more of the soil covered by residue at the time of planting (CTIC 2004), the minimum threshold for soil erosion mitigation.

2011 Tomato Cover Crop and Strip-till Demonstration Evaluation Sites




"Heavyweights in CT"
March 10 & 11, 2011
Five Points and Davis
Conservation Tillage Workgroup
Dwayne Beck
Dakota Lakes Research Farm
Mike Peterson
Precision Tillage, Orthman Mfg.
Andy McGuire
Washington State University
A 'once in a lifetime' opportunity
UC DAVIS
COLLEGE OF AGRICULTURAL AND ENVIRONMENTAL SCIENCES
UC DAVIS PLANT SCIENCES
Sustainable Conservation
RESOURCE CONSERVATION DISTRICTS


PROCESSING TOMATOES
STRIP-TILL PLANTED INTO
TRITICALE COVER CROP
FIREBAUGH, CA 2005
Conservation Tillage
WORKGROUP




Sanli-Urfa, Turkey
2008
Patos de Minas, Brazil
2007

We hope you might help us out by filling out the CT survey that we've prepared and also if there are 12 folks who might be interested in working with us for 10 minutes following this morning's meeting, we would like to hold a very brief focus group with you. We very much appreciate your time and help with this.

Thank you very much.