Controlled traffic, precision irrigation onion production evaluation

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Mother Nature…

- harvests the maximum amount of sunlight
- leaks very few nutrients including CO_2
- has diversity
- does not export nutrients
- makes maximum use of water and nutrients by having highly developed porosity and VAM webs

does not do tillage

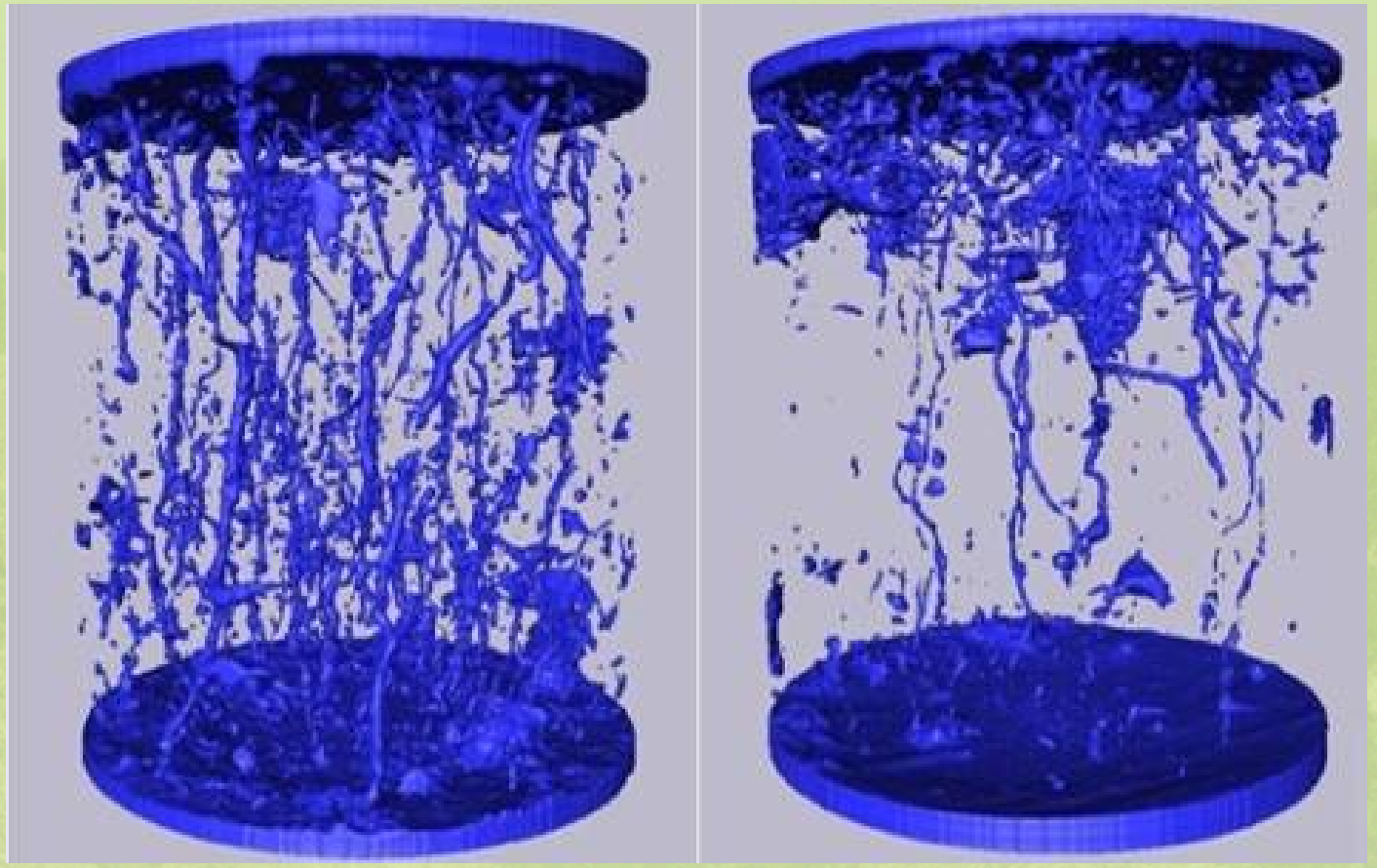
Summary of comments made by Dr. Dwayne Beck, SDSU, at 2014 Winter Conference of No-till on the Plains, Salina, KS

Managing for soil health …

- Minimizing soil disturbance
- Maximizing the diversity of plants in rotation / cover crops
- Keeping living roots in the soil as much as possible, and
- Keeping the soil covered with plants and plant residues at all times

Unlock the Secrets in the Soil

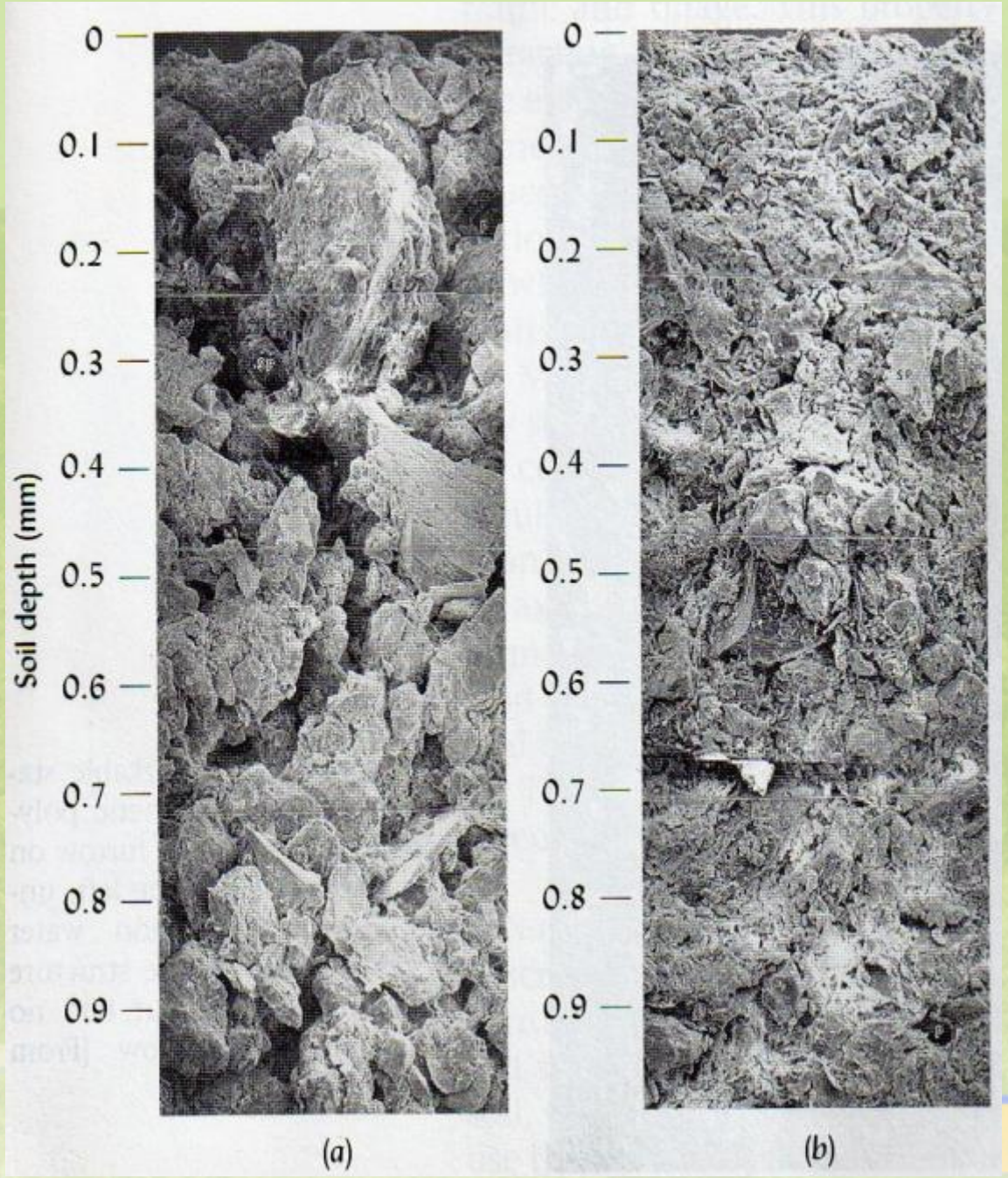
http://www.nrcs.usda.gov/wps/portal/nrcs/main/national/soils/health/



Macropores in non-compacted soil

Macropores in compacted soil

Schjonning et al., 2013



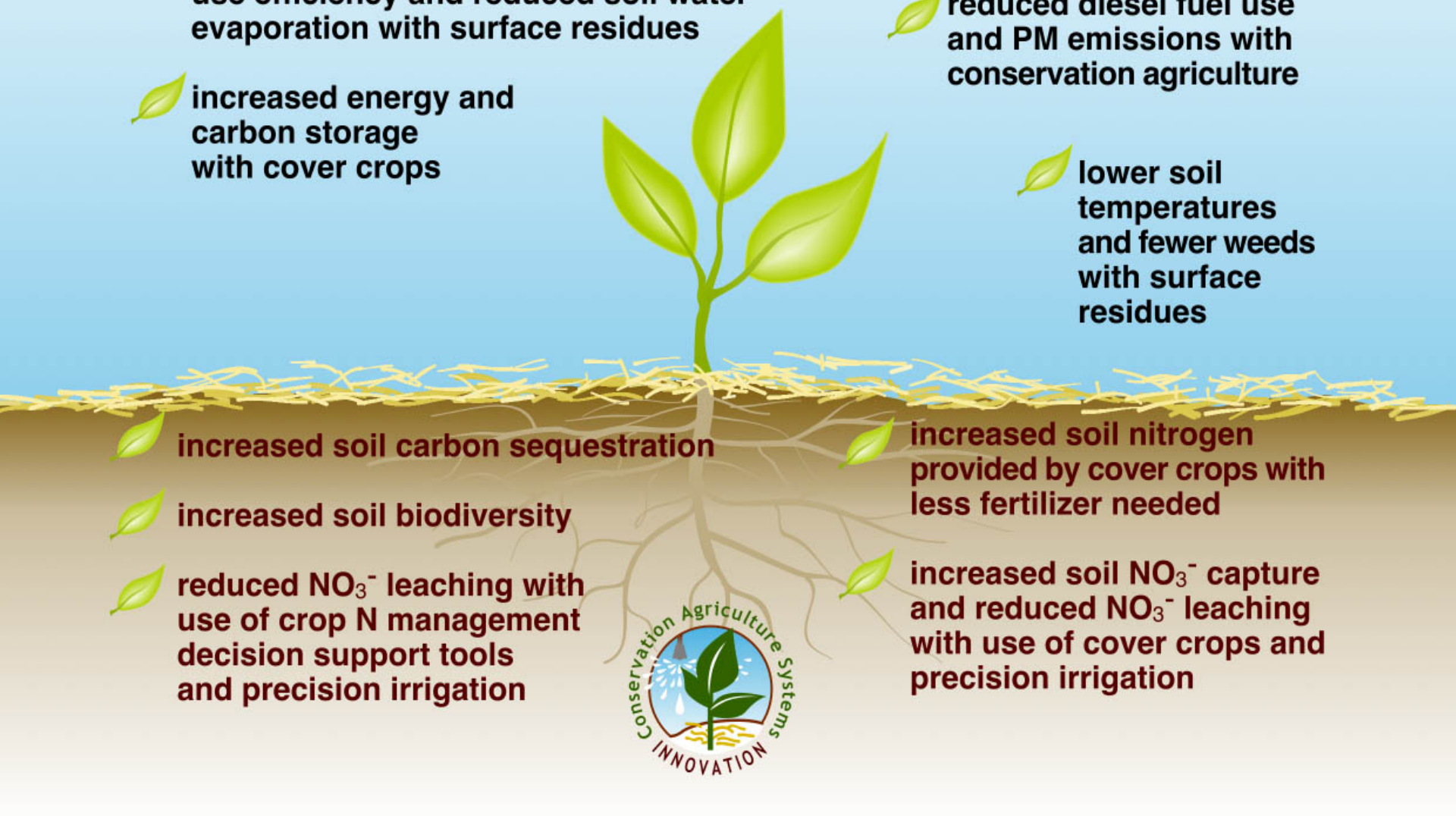
Winger, 2014

Soil improving practices

1. Feed the soil (OM) (not take away everything, not mine the soil)
2. Reduced soil disturbance (physical, chemical, and biological)
3. Increase diversity (biodiversity)
4. Keep the soil covered
5. Minimize diversity-reducing inputs
6. Promote optimal soil structure
7. Reduce extremes in temperature
8. Build soil carbon
9. Use diverse cover crops
10. Rotate crops
11. Manage salinity
12. Manage nitrogen
13. Precision irrigation
14. Decrease soil-borne pests
15. Reduce compaction
16. Monitor soil conditions (lab analyses)

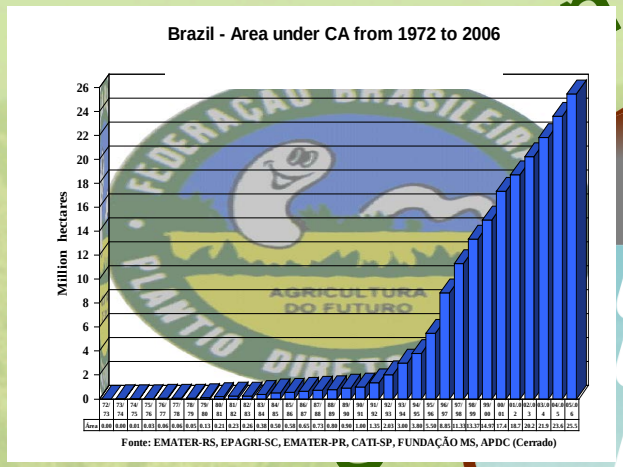
This list was developed in a meeting with farmers, NRCS conservationists, private sector consultants, and university researchers held at the UC West Side Research and Extension Center in Five Points, CA, April 23, 2013.

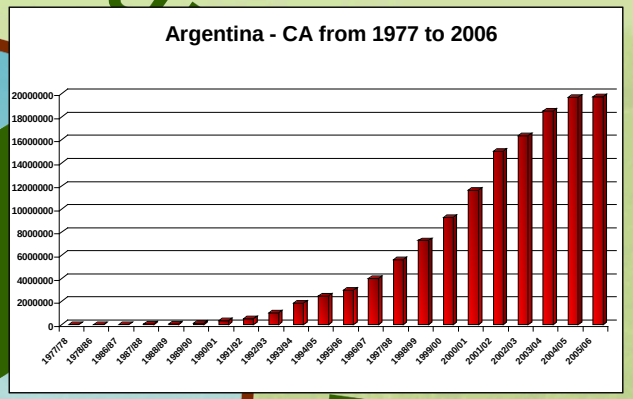
Advanced Conservation Agriculture Benefits

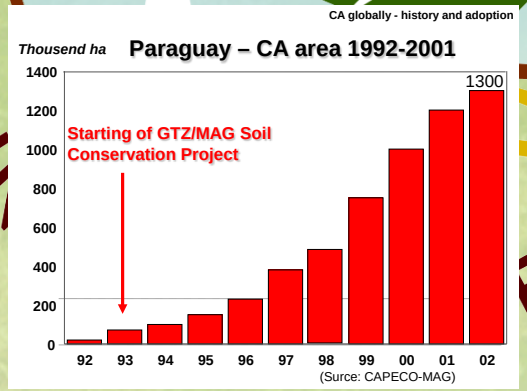


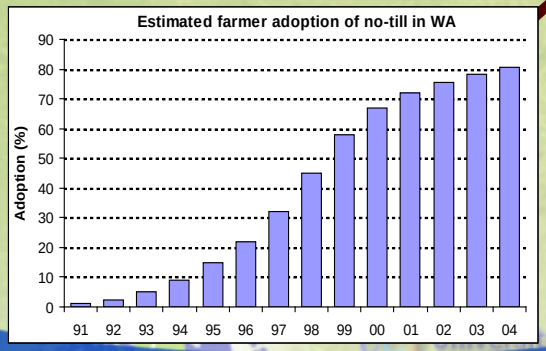
- lower production costs
- reduced pumping time due to increased water use efficiency and reduced soil water evaporation with surface residues
- increased energy and carbon storage with cover crops
- reduced diesel fuel use and PM emissions with conservation agriculture
- lower soil temperatures and fewer weeds with surface residues
- increased soil carbon sequestration
- increased soil biodiversity
- reduced NO_3^- leaching with use of crop N management decision support tools and precision irrigation
- increased soil nitrogen provided by cover crops with less fertilizer needed
- increased soil NO_3^- capture and reduced NO_3^- leaching with use of cover crops and precision irrigation

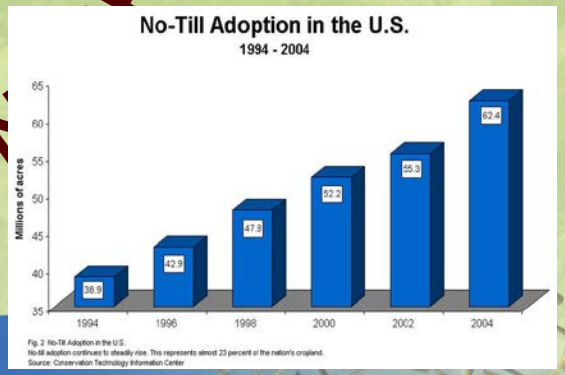
Conservation Agriculture Systems INNOVATION











University of California
Agriculture and Natural Resources
Making a Difference for California

soil

disease control

harvest efficiency

return on investment

emissions

labor

profitability

regulations

insect control

soil life

RETHINK THE SYSTEM

residues

weed control

equipment

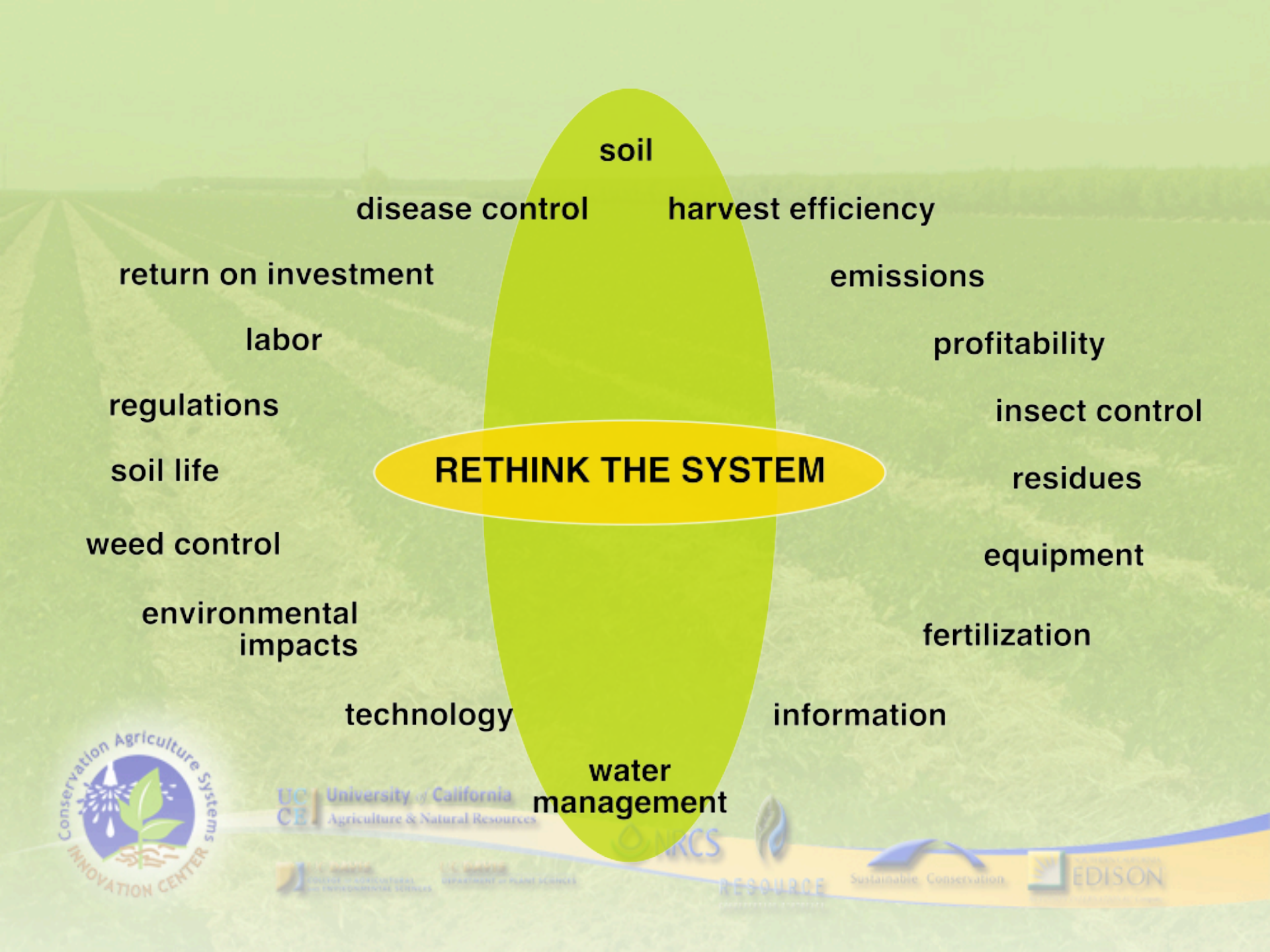
environmental impacts

fertilization

technology

information

water management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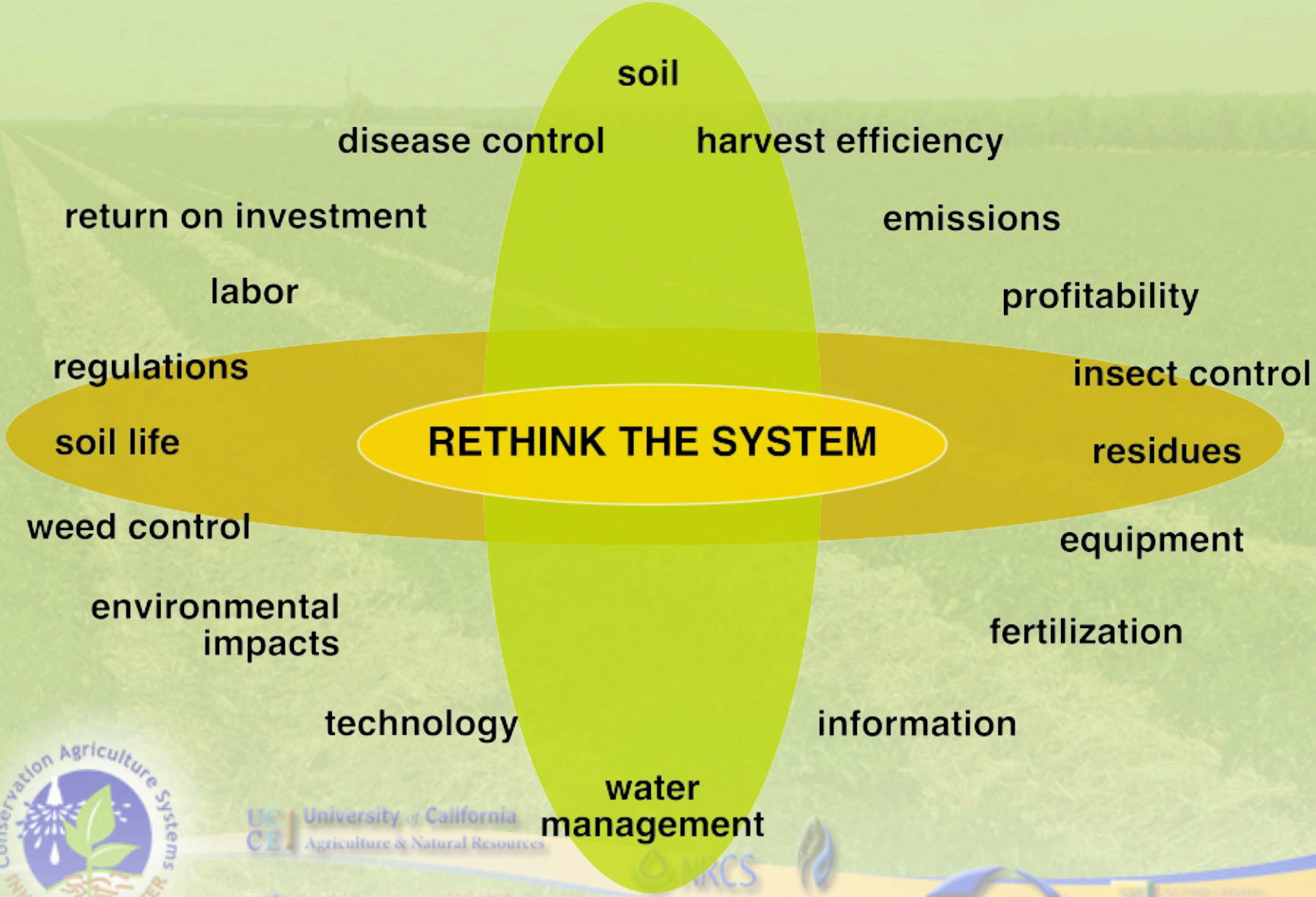
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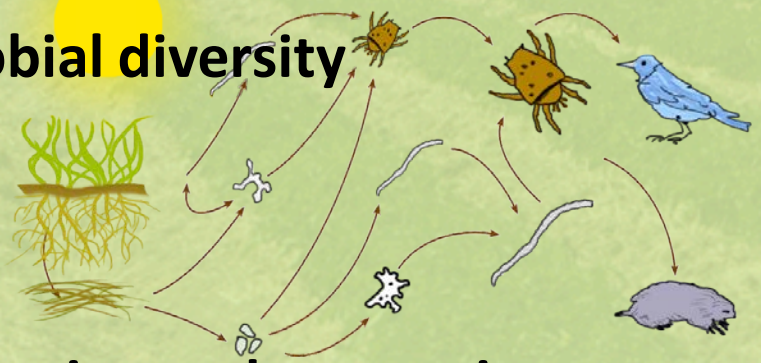
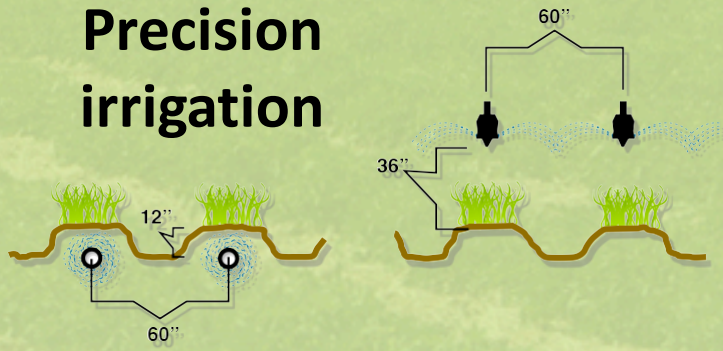
Merging practices and technologies to achieve advanced conservation agriculture systems

"No-till is a tool for what we're trying to achieve."

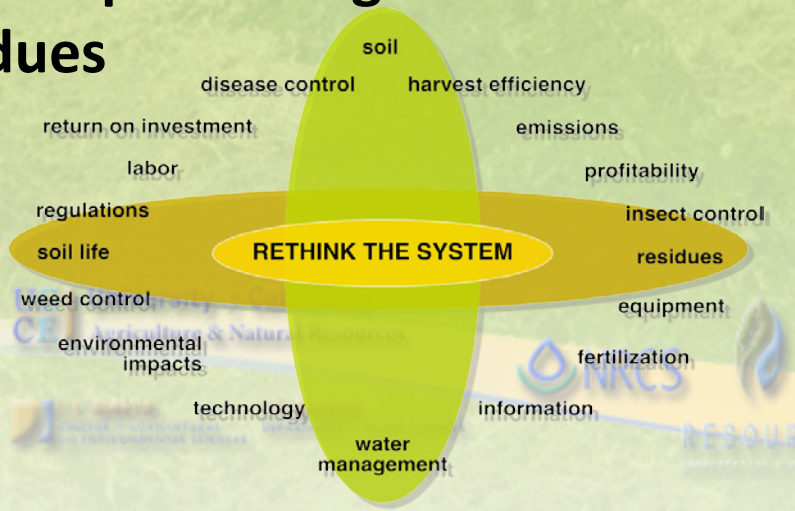
Microbial diversity



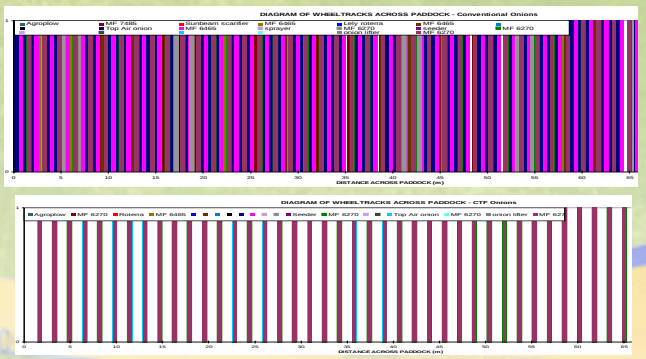
Precision irrigation



Generating and preserving surface residues

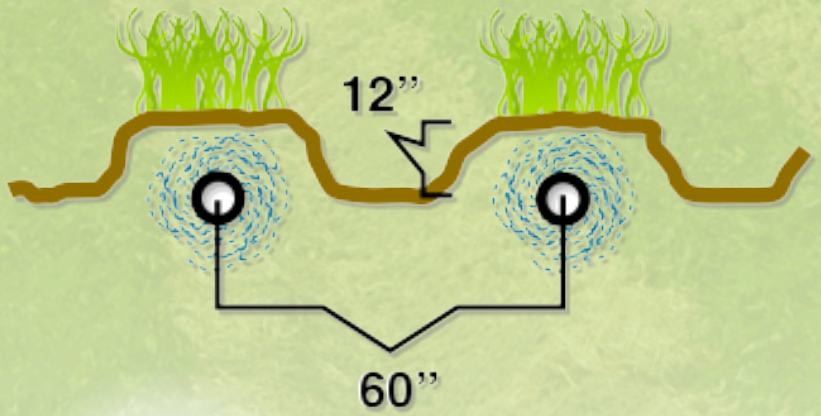


Controlled traffic farming

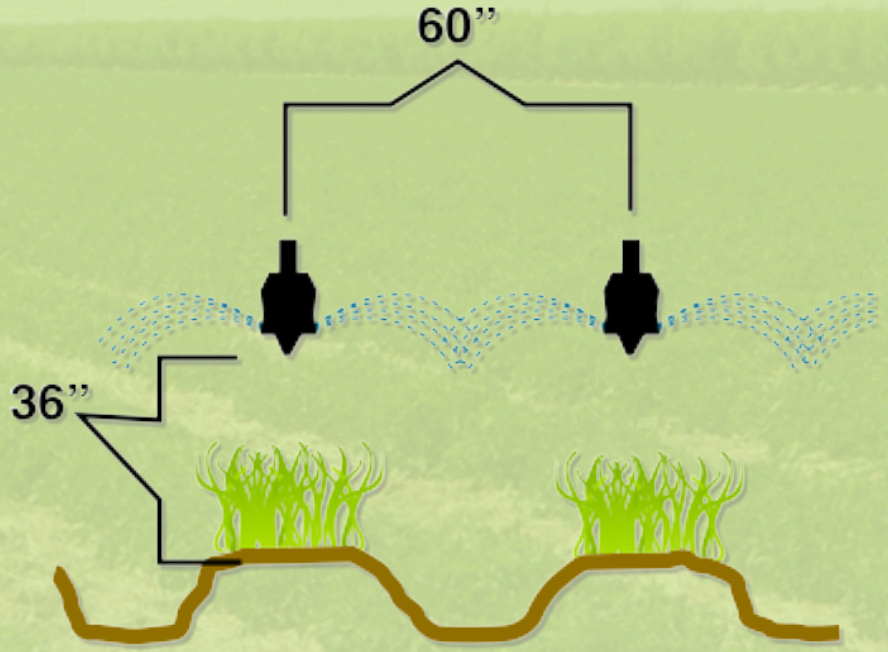


DRIP minimum tillage
DRIP no-tillage
OVERHEAD minimum tillage
OVERHEAD no-tillage

SUBSURFACE DRIP IRRIGATION SYSTEM



OVERHEAD MECHANIZED IRRIGATION SYSTEM



‘We did this so that you wouldn’t have to.’

Onion CTF, precision tillage and irrigation system comparison

- 2011
  - Seeded on November 3 – 5
- 2013
  - Seeded on January 10 – 11

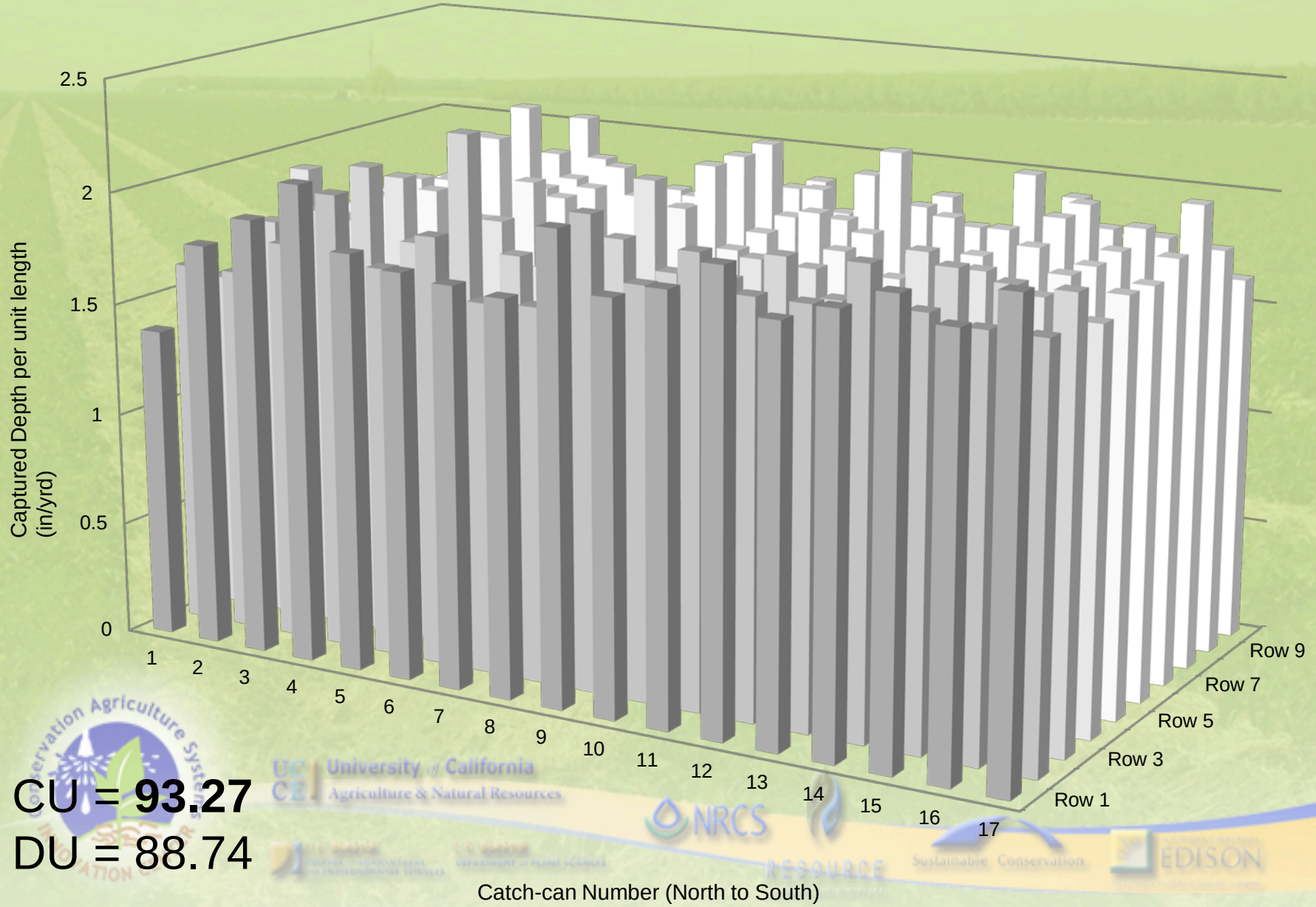
Onion CTF, precision tillage and irrigation system comparison

- 2011
  - Drip 272 lbs N / ac
  - Overhead 272 lbs N / ac
- 2013
  - Drip 268 lbs N / ac
  - Overhead 281 lbs N / ac

Our experimental context and field set-up

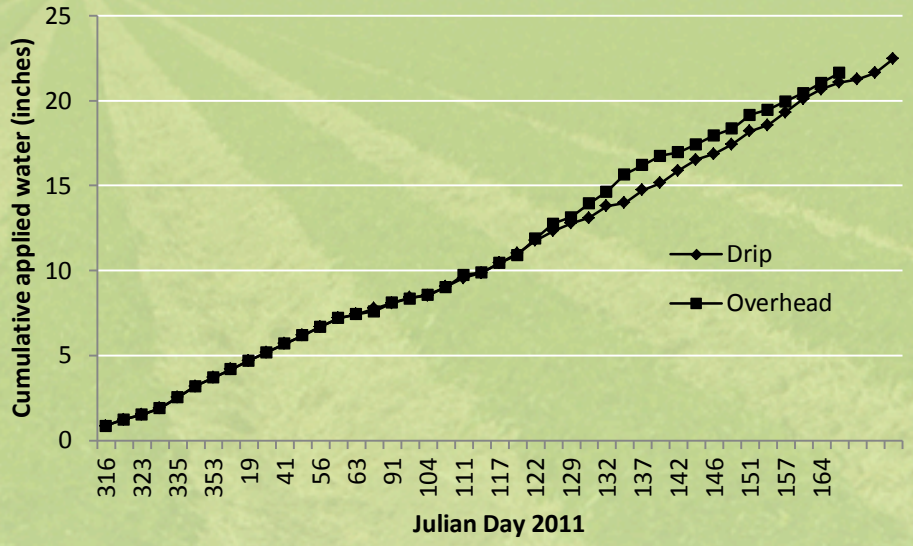
These beds are CTF, essentially no-till with only a surface raking operation ahead of planting.

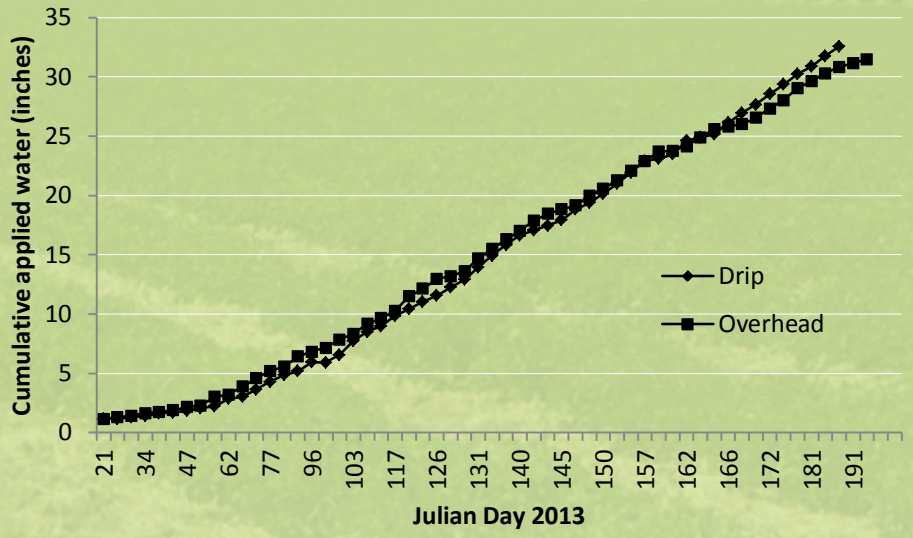
Catch-Can Captured Depths - August 21, 2009



CU = **93.27**

DU = 88.74





Conservation Agriculture Systems Innovation Center

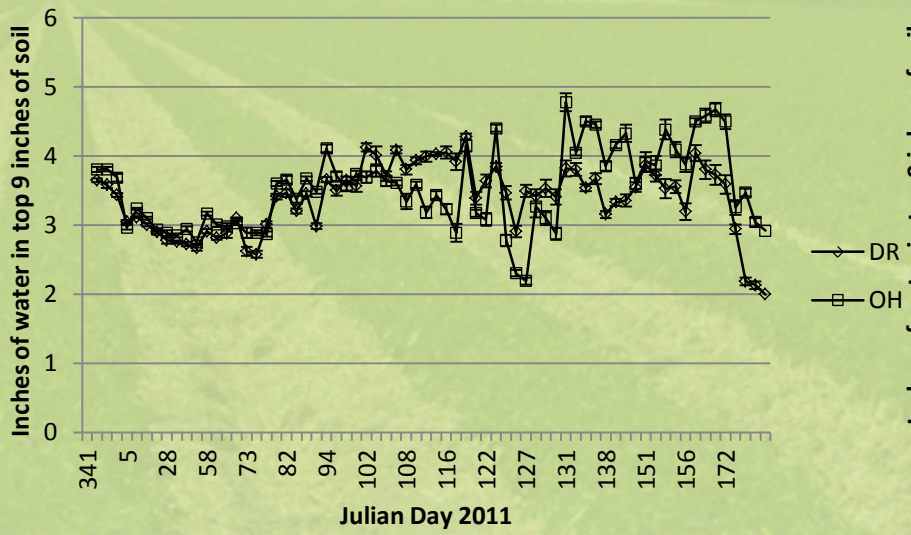
UC CE University of California Agriculture & Natural Resources

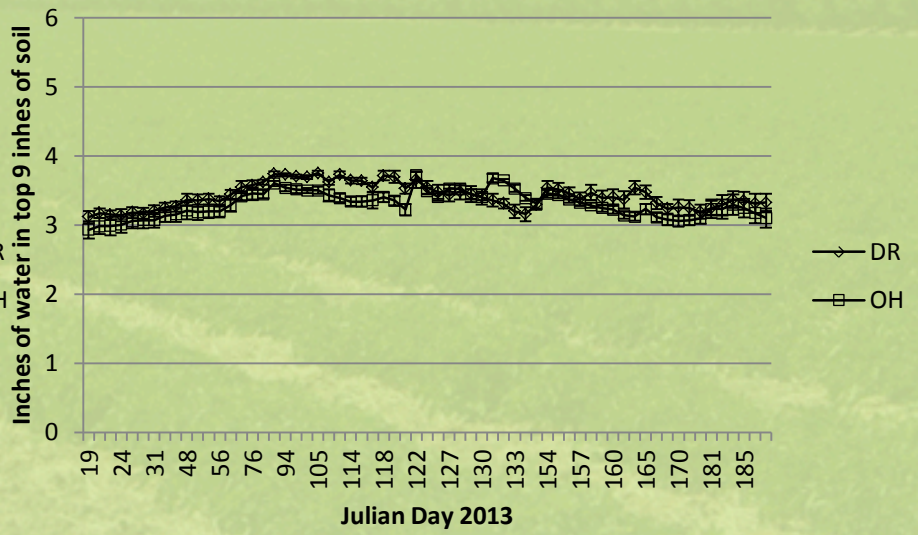
NRCS

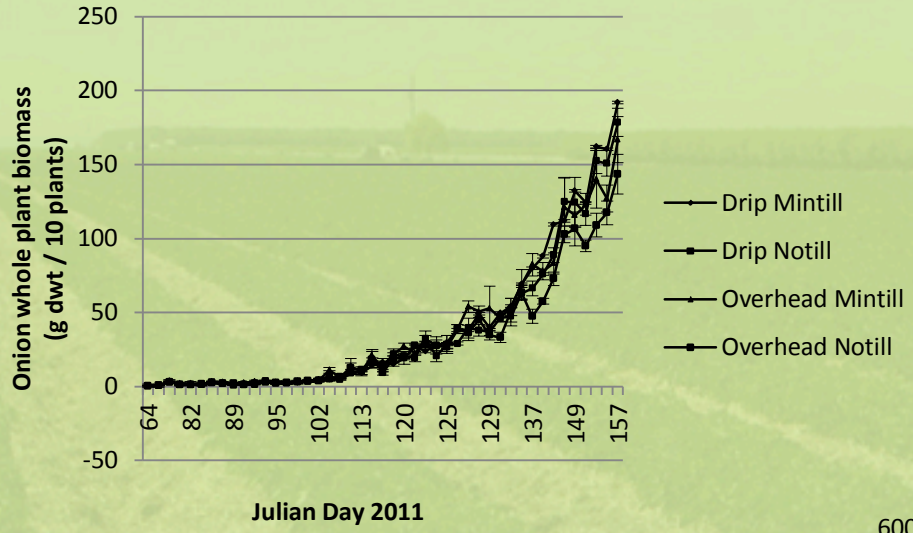
Resource

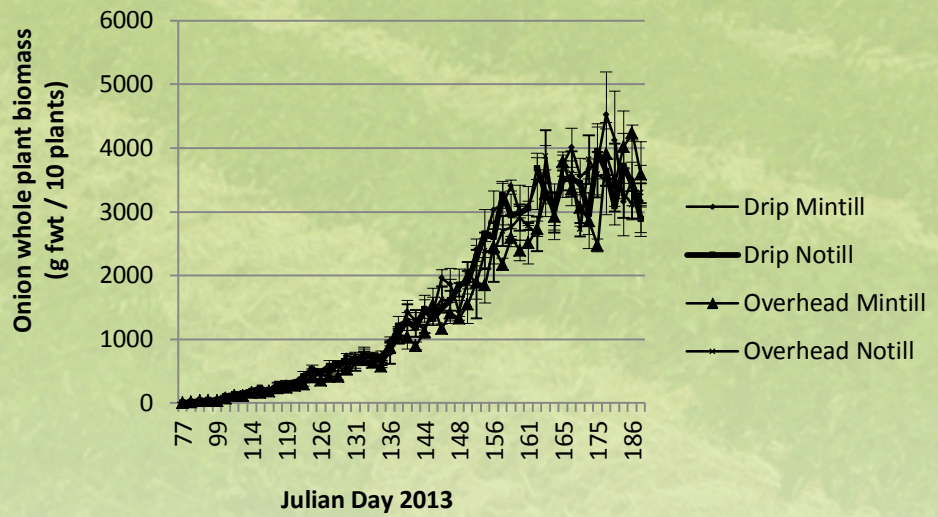
Sustainable Conservation

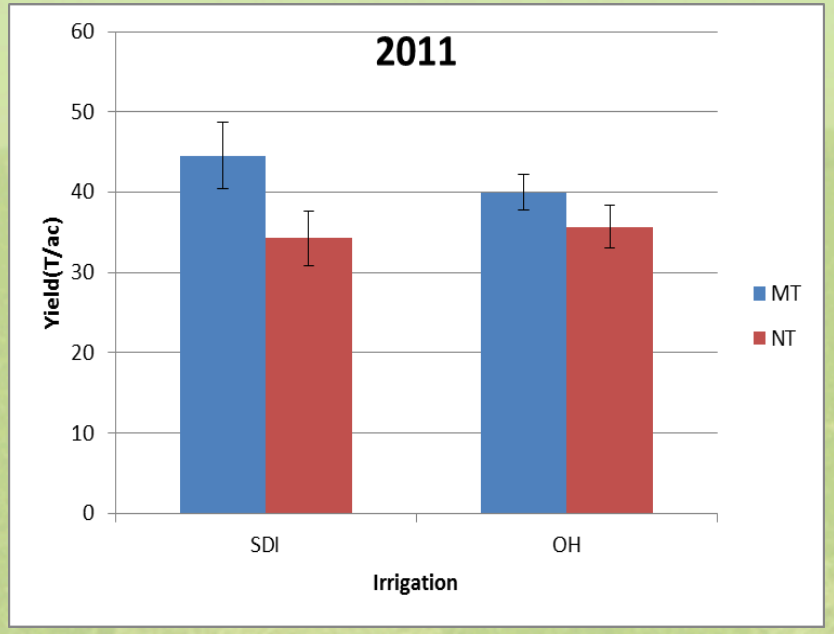
EDISON

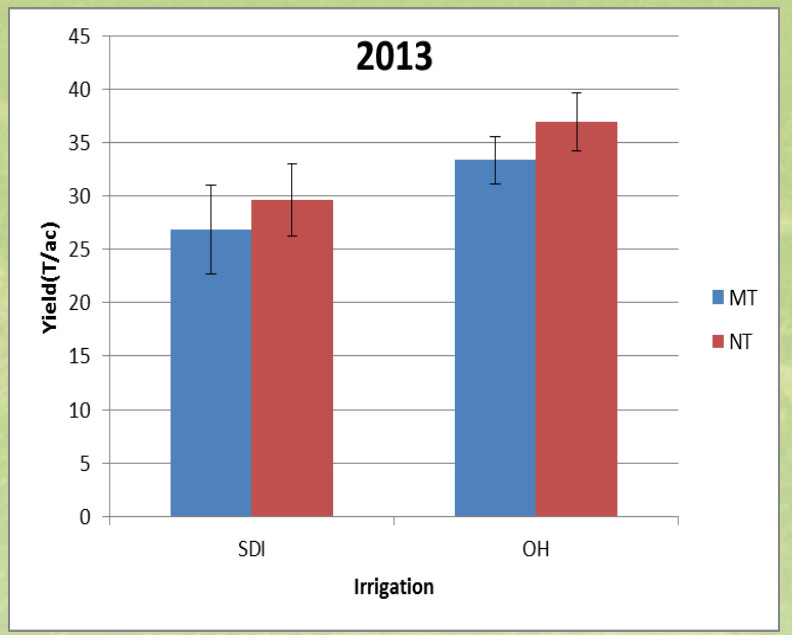

Inches of water in top 9 inches of soil
0
1
2
3
4
5
6
341
5
28
58
73
82
94
102
108
116
122
127
131
138
151
156
172
Julian Day 2011
DR
OH


Inches of water in top 9 inhes of soil
0
1
2
3
4
5
6
19
24
31
48
56
76
94
105
114
118
122
127
130
133
154
157
160
165
170
181
185
Julian Day 2013
DR
OH


Onion whole plant biomass (g dwt / 10 plants)
250
200
150
100
50
0
-50
64
82
89
95
102
113
120
125
129
137
149
157
Julian Day 2011
Drip Mintill
Drip Notill
Overhead Mintill
Overhead Notill


Onion whole plant biomass (g fwt / 10 plants)
6000
5000
4000
3000
2000
1000
0
77
99
114
119
126
131
136
144
148
156
161
165
175
186
Julian Day 2013
Drip Mintill
Drip Notill
Overhead Mintill
Overhead Notill





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NRCS
Sustainable Conservation
EDISON

Partial onion production budget comparison

- 4 onion farmers interviewed
  - Yields
  - Gross returns
  - Irrigation system costs
  - Tillage costs
  - ‘the value of 5” of water’
- Data averaged for FM and DEHY systems
- Ranges of data also shown
- Current conventional system then compared to CTF, OH, and NT system

Partial onion production budget comparison

- **YIELD**
  - FM - 40 T/ac (40T/40T)
  - DEHY - 19.6 T/ac (19T/19T/21T)
- **RETURN**
  - FM - $175/T ($100/$250)
  - DEHY - $125/T ($165/$80/$130)
- **SPRINKLER/DRIP COSTS** - $431/ac ($500/$450/$475/$128)
- **TILLAGE COSTS** - $88/ac ($60/$70/$80/$152)
- **5” of water** - $165/ac ($150/$125/$200/$200)

- **Total Potential Savings** - $684/ac

Partial onion production budget comparison

Therefore, with a 'potential' $684/ac savings,
one would only need to reach
90% of conventional yields for FM onions, and
72% of conventional yields for DEHY onions
to break even.

Issues that need to be addressed:

- ‘It’ll be tough.’
- ‘The biggest problem will be weeds.’
- ‘It could work if you start in a clean field.’
- ‘You need to chemigate with sprinklers for weed control.’
- ‘The biggest problem with pivot irrigation is water penetration.’
- ‘You can’t get water in the ground with OH.’
- ‘You lose from 35 – 50% to evaporation with OH.’
- ‘If you have a lot of trash on the beds, you may get seed corn maggot.’
- ‘Muck soils devastate onions.’

Issues that need to be addressed:

- ‘Neck rot is the big thing.’
- ‘You may need seed pretreatments.’
- ‘You may need to be using Cl- in the water as a management option with OH.’
- ‘Soft rot bacterial diseases are a problem.’
- ‘If you grow onions following wheat and you use a minimum tillage, green manure approach, you may have a problem getting a stand through the residue.’
- ‘In WA, they use hard varieties with small necks.’

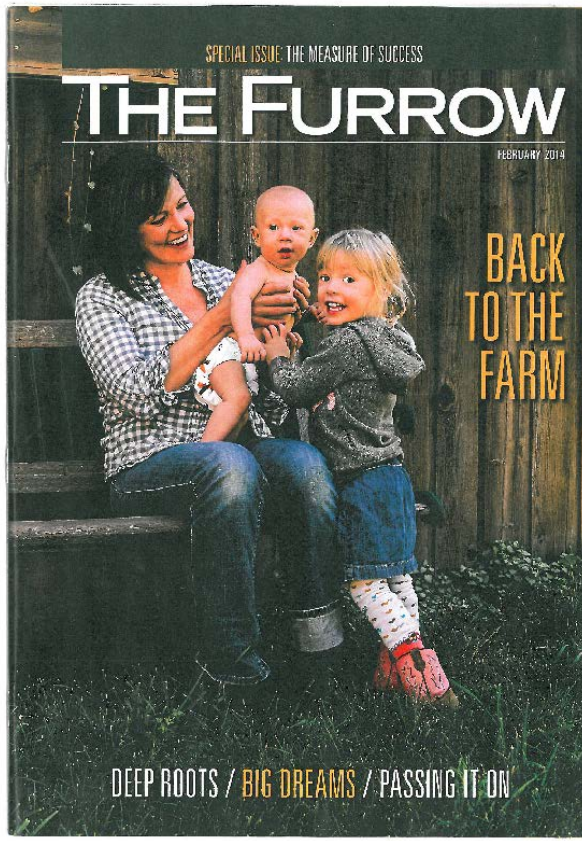
Strip-till seeded onions in wheat cover crop
Moses Lake, WA
2010

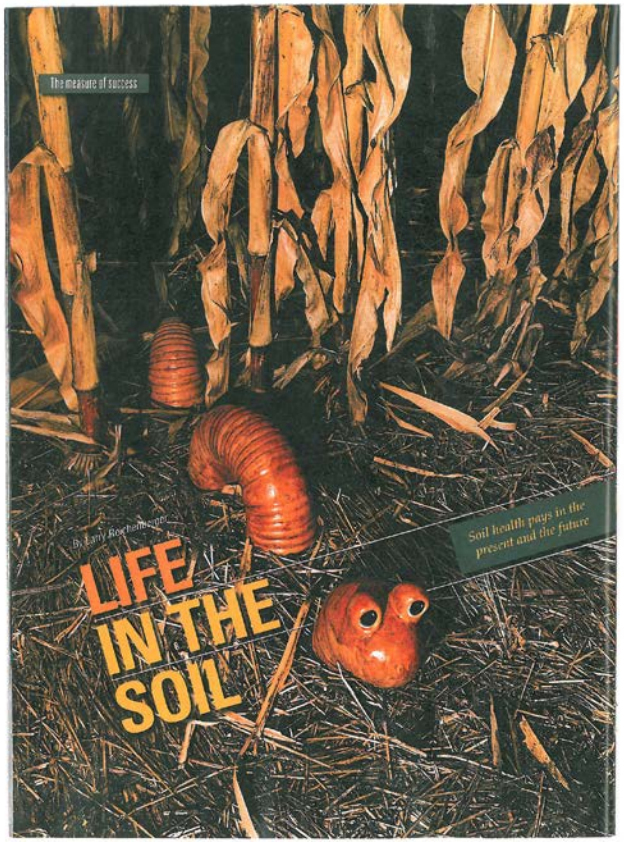
Center-pivot mechanized irrigation is used.
Moses Lake, WA
2010

Commercial state-of-the-art dehydrator onion field under center pivot irrigaton
Five Points, CA
2011

No-till onion experimentation
Patos de Minos, BRAZIL
2006

High residue no-till established onion seedlings
Patos de Minos, BRAZIL
2006





Healthy soils are the ultimate measure of success for Rick Bieber. With the zeal of an evangelist, this Trail City, S.D., farmer promotes methods that enhance soil quality. He swears by the old adage, "If you take care of your soil, your soil will take care of you."

"The soil is the greatest source of wealth in the world, but most farmers squander its potential," says Bieber, who farms with his son, Ben. "The soil isn't just a tool, it's a full partner in a farming operation and deserves to be treated with respect. Learn to protect the soil and to manage it like it's really alive — because it is — and you will see an unbelievable response."

Diversity in crops. Bieber's recipe for a healthy soil includes long-term no-till, intensive crop rotation, and cover crops. "We started no-tilling in 1987 and soon learned we needed to diversify and intensify our crop rotation to utilize the moisture we were saving and to boost microbial activity in the soil. From wheat/fallow and wheat/corn/fallow, we changed to rotations that also include chickpeas, millet, flax, sunflowers, and alfalfa. More recently, we've added cover crops that are planted after wheat and interseeded into growing corn."

"Now, our yields are higher with fewer inputs so profitability has increased. And, the impact of drought, heat, and other stress is less. Our 10-year proven corn yields are 408% of the county average, and wheat yields are 358% of the norm," adds Bieber.

Credit the soil. Bieber is quick to deflect credit for this performance. "It's totally due to the soil — all I've done is provide what the soil tells me it needs to do its job," he says.

What Bieber provides is a steady supply of carbon — in the form of crop residue and living plant roots — that feeds soil microbes, moderates soil temperatures to protect the microbes, shields the soil surface from erosion, and builds soil organic matter levels.

Bieber measures performance of his system is various ways. "We used to apply 90 pounds per acre of nitrogen and produce 90-bushel corn, but now the same amount of nitrogen produces 160 bushels. That's due mainly to our soil organic matter levels, which are 4-5% in our long-term no-till."

In contrast, typical conventionally tilled fields in Bieber's area have soil organic matter levels around 2%. Soil with higher organic matter not only mineralizes more nitrogen, it also holds more water, and that's the farm's major benchmark of success.

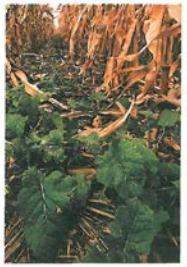
"We judge our management skills by the amount of grain we produce per inch of rainfall, and we've seen this water-use efficiency increase as our soil health has improved. In 1998 we produced just over 4 bushels of corn per inch of rainfall. By 2001, the first year corn in our rotation grew on cover crops grown in 1998, that had increased to 5.4 bushels per inch. By 2007, that efficiency had increased to 6.23 bushels per inch of rainfall."

Best combination. Bieber worked with agronomist Cheryl Reese from South Dakota State University on an intensive cover crop study from 2009 through 2011. "There were 96 trials, and they showed that the best combination of cover crops and fertilizer rates resulted in 12.6 bushels of corn per inch of rainfall. Then in 2012, with a severe drought, corn on our long-term, no-till ground produced 9.54 bushels per inch of rainfall while some new ground — in its first year of no-till — produced only 4 bushels per inch. That was amazingly similar to what we saw in 1998," says Bieber.

Hungry soil. His water use efficiency data has convinced Bieber that his soils are hungry for live roots, even in dry years. "Living plants sequester carbon from the atmosphere and deposit it in the soil through their root system, so we want to have something growing every moment that the season allows," he says.

Cover crops allow Bieber to put this conclusion into practice. "We hire an extra man so we can plant cover crops right behind the combine during wheat harvest. And, the cover crops we interseed at the V-6 stage of our corn stay alive well after the corn matures in the fall," he says.

"We're protecting soil not just for the next generation, but for those 100 and 1,000 years from now," he adds. ■



►**Left:** Rick Bieber says healthy soil makes farming fun — a point emphasized by this giant earthworm he poses for frequent visitors to his farm.

►**Left center:** High organic matter levels have turned Bieber's soils black and fostered a teaming population of earthworms. ►**Left:** Cover crops, including radishes and turnips, are broadcast into corn at the V-6 stage to extend the growing season and improve winter grazing.

"'Soil care' is what we're doing."

Rick Bieber
Trail City, SD
January 28, 2014

2014 Winter Conference of No-till on the Plains

Salina, KS

January 27 – 28, 2014

‘Take the hardest crop you have and show that it will work.’

Rick Bieber

Trail City, SD

‘Rethinking the system’

Do you have a plan for ‘soil care?’

Would you be interested in working with others in the SJV to learn more about advances in ‘soil health’ and opportunities for improving it in your own system?

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Sustainable Conservation

Thank you.

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COLLEGE OF AGRICULTURAL
AND ENVIRONMENTAL SCIENCES

UCDAVIS
DEPARTMENT OF PLANT SCIENCES

University of California
Agriculture and Natural Resources

Making a Difference for California

http://www.youtube.com/watch?v=ToKavHhu4PE