Using Saline Groundwater for Large-Scale Development and Irrigation of Pistachios Interplanted with Cotton

2009 Proposal Defense
1/15/09  Kearney Ag Center

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Large-Scale Utilization of Saline Groundwater for Development and Irrigation of Pistachios Interplanted with Cotton

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Cooperator: Starrh & Starrh Farming

Funding: University of California Salinity/Drainage Taskforce & Water Resources Center, CA Pistachio Research Board
Changes in cotton and pistachio acreage from 1980 to 2005

SJV Cotton (1,000 ac)

SJV Pistachio (1,000 ac)

- Cotton
- Pistachio
More than ¼ million acres along the Westside of the San Joaquin Valley are affected by poor drainage, perched water and salinity.

**ISSUE:** Partial or full reuse of saline drainwater for irrigation of pistachios may provide a profitable alternative to cotton/forage production and evaporation pond disposal.

**QUESTION:** Is pistachio salinity tolerance sufficient to maintain high levels of yield typical for the Westside of the San Joaquin Valley?
ORIGINAL STUDY

Potential for Using Drainage Water for Irrigating Westside San Joaquin Valley Pistachios

OBJECTIVES

1. **SALINITY TOLERANCE**
   
   Determine salinity threshold, and possibly slope of pistachio yield decline in a high production setting.

2. **CROP WATER USE & SALINITY**
   
   Determine the impact of salinity on ET.

3. **CROP PHYSIOLOGY**
   
   Examine the consequences of salinity on tree photosynthesis and water status.
40 acre pistachio orchard planted 1989

**Soil:** calcareous Twisselman silty clay

**Spacing:** 5.2 x 6.1m (17 x 20 feet)

**Irrigation:** One 55 lph (14.5 gph) microsprinkler/tree centered between trees with 12 static jets @ 360° and a wetted diameter of 4.3m (14 feet). Established with CA Aqueduct water.

Salinity trial initiated April 1994, terminated November 2002. (Trial size = 12 trees x 20 rows)
Plot Layout in Orchard

<table>
<thead>
<tr>
<th>BLOCKS</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
</tr>
<tr>
<td>2</td>
</tr>
<tr>
<td>3</td>
</tr>
<tr>
<td>4</td>
</tr>
</tbody>
</table>

- 0.5-0.7 dS/m
- 4 dS/m
- 8 dS/m
- 12 dS/m
Marginal burn on 0.7 dS/m UCB
Rep 2 (9/16/02)

No marginal burn on 0.7 dS/m UCB
Rep 1 (9/16/02)
Precipitated salts on soil surface in 12 dS/m plot (10/13/00)

SALINITY TRIAL IRR. WATER @ 8 dS/m

Na: 60 meq/l  Cl: 40 meq/l  B: 1 ppm
1,380 ppm  1,400 ppm
2002 “Zone” and “Mean” calculated ET’s compared

- **Zone Cumulative ET (mm):**
  - 0.7 dS/m: 1612 mm
  - 4 dS/m: 1594 mm
  - 8 dS/m: 1280 mm
  - 12 dS/m: 935 mm

- **Mean Cumulative ET (mm):**
  - 0.7 dS/m: 1448 mm
  - 4 dS/m: 1308 mm
  - 8 dS/m: 1080 mm
  - 12 dS/m: 794 mm
Soil water content and leaf water potential for 2002 season

Total soil water content over 2002 season as determined by neutron backscatter

Bagged Leaf Water Potential (MPa)

0.7 dS/m 4 dS/m 8 dS/m 12 dS/m

2002 Pistachio Bagged Leaf Water Potentials
### Cumulative Yields by Salinity

**Cumulative and (Average Annual) Yield per tree; 1997 - 2002**

<table>
<thead>
<tr>
<th>Yield (kg/tree)</th>
<th>Rootstock</th>
<th>0.75 / 4.7*</th>
<th>4.0 / 8.7*</th>
<th>8.0 / 11.3*</th>
<th>12.0+ / 13.2*</th>
<th>12 dS/m yield as a % of control yield</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rootstock</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Atlantica</td>
<td></td>
<td>46.3 (7.7)</td>
<td>47.3 (7.8)</td>
<td>42.4 (7.1)</td>
<td>38.0 (6.3)</td>
<td>82%</td>
</tr>
<tr>
<td>PGI</td>
<td></td>
<td>57.3 (9.6)</td>
<td>52.1 (8.7)</td>
<td>51.6 (8.6)</td>
<td>51.8 (8.6)</td>
<td>90%</td>
</tr>
<tr>
<td>PGII</td>
<td></td>
<td>50.3 (8.4)</td>
<td>51.8 (8.6)</td>
<td>54.6 (9.1)</td>
<td>42.9 (7.2)</td>
<td>85%</td>
</tr>
<tr>
<td>UCB1</td>
<td></td>
<td>56.0 (9.3)</td>
<td>62.0 (10.3)</td>
<td>53.6 (9.4)</td>
<td>36.2 (6.0)</td>
<td>65%</td>
</tr>
</tbody>
</table>

*Soil salinities are end of season 2002 values.
+12 dS/m irrigation was only applied for 1997 through 2002 seasons.

### 8th-13th Leaf Average Annual Yield for 0.75 to 8 dS/m water (lb/ac):

<table>
<thead>
<tr>
<th></th>
<th>PG1</th>
<th>UCB1</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yield</td>
<td>2,531</td>
<td>2,727</td>
</tr>
</tbody>
</table>
Relative yield of as a function of soil ECe

Cotton Relative Yield = 100 - 5.2(ECe - 7.7)

Pistachio Relative Yield(%)

= 100 - 8.4(ECe-9.4)

Location of salinity trial

California Aqueduct

Lerdo Highway

Belridge Oilfield

Location of salinity trial
Sodium (50 meq/l, 1150 ppm) and chloride (65 meq/l, 2301 ppm) burn on sprinkler irrigated cotton.
Large-Scale Utilization of Saline Groundwater for Development and Irrigation of Pistachios Interplanted with Cotton
Objectives

1. Assess the viability of large-scale cotton production and pistachio interplanting using saline groundwater (EC 5 dS/m and B @ 10 ppm) and optimal irrigation scheduling with SDI.

2. Determine crop ET as a function of salinity using simple water and chloride balance.

3. Maintain acceptable soil salinity levels for cotton stand establishment/production and maximum growth of young pistachios.

4. Compare total project profitability under SDI using 3 different levels of salinity: saline water, non-saline CA Aqueduct water and a 50/50 blend.
Treatments/Timetable

Control: Aqueduct water only  EC ~ 0.5 dS/m
Blend: 50/50 mix of above  EC ~ 2.5 dS/m
Well: Shallow groundwater only  EC ~ 5.0 dS/m

2004: Cotton only planted

2005-2008: Pistachios are planted on 6.7m row spacing with 4, 0.97m rows of cotton in between trees. Trees are irrigated with cotton but on a reduced frequency in order to just satisfy ET and some leaching to maintain rootzone ECe < 8 dS/m.

(All treatments receive fresh water preirrigation of 150 to 300 mm, depending on water district availability, to recharge rootzone and germinate cotton.)

2009 on: Pistachios only
Belridge Salinity Trial
-- 2, 155 acre fields
-- 12, 19.5 acre testplots
Data Collection:

**Soil water content:** replicated neutron probe sites for weekly measured depletion/ET, data logger/Watermark blocks recording estimated matric potential using electrical resistance.

**Soil salinity patterns:** sampling, at planting and post harvest. GIS survey with EM38 and aerial imagery.

**Plant data:** leaf water potential monthly just prior to the start of irrigation. Trunk diameter annually. Leaf tissue Ca, Mg, Na, Cl, B and petiole NO3, P and K. Lint yield and quality.

Drip tape spacing showing "blank" areas for separation of cotton & 2005 pistachios, which will be planted to a 22 foot spacing.
• Tape: TSX 12-220 @ 0.875 in diameter
• Emitters: spaced @ 12 inches
• Depth: 9 to 10 inches below bed.
• Run: 1280 to 1300 feet
• Cotton rows: 38 inches
• Irrigation depth: 1.97 in/day

SDI tape system installed January 2004
Measured irrigation "distribution uniformity"

DU = 94.9%.

1300 foot hose runs follow field grade down-slope from manifolds.
## Treatment Water Quality

<table>
<thead>
<tr>
<th>WATER SOURCE</th>
<th>pH</th>
<th>EC</th>
<th>SAR</th>
<th>Ca (meq/l)</th>
<th>Mg (meq/l)</th>
<th>Na (meq/l)</th>
<th>Cl (meq/l)</th>
<th>B (ppm)</th>
<th>HCO3 (meq/l)</th>
<th>CO3 (meq/l)</th>
<th>SO4 (meq/l)</th>
<th>NO3-N (ppm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aqueduct</td>
<td>8.0</td>
<td>0.55</td>
<td>2.5</td>
<td>1.2</td>
<td>1.0</td>
<td>2.6</td>
<td>2.2</td>
<td>0.3</td>
<td>1.3</td>
<td>&lt;0.1</td>
<td>0.7</td>
<td>0.3</td>
</tr>
<tr>
<td>Blend</td>
<td>7.6</td>
<td>3.41</td>
<td>4.1</td>
<td>14.1</td>
<td>7.8</td>
<td>13.6</td>
<td>21.2</td>
<td>6.3</td>
<td>1.4</td>
<td>&lt;0.1</td>
<td>9.9</td>
<td>2.9</td>
</tr>
<tr>
<td>Well</td>
<td>7.6</td>
<td>5.15</td>
<td>5.2</td>
<td>22.7</td>
<td>12.7</td>
<td>21.8</td>
<td>33.5</td>
<td>10.4</td>
<td>1.5</td>
<td>&lt;0.1</td>
<td>19.6</td>
<td>6.8</td>
</tr>
</tbody>
</table>
Data Collection and Analysis (the following data will be collected in both cotton and pistachios):

Soil water content and applied water:
- Neutron probe weekly measured depletion/ET
- Soil matric potential at the 12, 24 and 48 inch depths adjacent to probe site
- Weekly applied water through drip tape in both cotton and pistachios.

Soil and water salinity:
- Replicated soil samples from 0-6, 6-18, 18-36 and 48-60 inch depths at planting and post harvest
- Analyzed for EC, Ca, Mg, Na, Cl, HCO3, and B.
- Treatment water samples collected at the same time.
- Transect of closely spaced samples characterize bed salinity patterns.

Plant data:
- Replicated leaf water potential bimonthly (cotton and pistachio)
- Trunk diameter annually (pistachio)
- Leaf tissue Ca, Mg, Na, Cl, B, N, P, K (pistachio) and petiole NO3, P, K and B (cotton) mid-season.
- Lint yield and quality.
Recommended irrigation schedules are provided to the grower on a weekly basis for both cotton and pistachios for all treatments. In practice, all treatments are irrigated to supply slightly less than ET demand for the 0.5 dS/m treatment.
Pima planted solid March 11-25, 2004
Delta Pine 340ELS
Pistachios (July 2005):
Drip tape 9 inches below surface and 16 inches either side of pistachios with 56 inch space to tape in adjacent cotton bed. Pistachio spacing 17x22 ft.

Pistachio rootstock planted 3/5-11/05
Delta Pine 340 planted 3/25-4/15/05

Pistachio irrigation @ 22 ft spacing: 0.60 in/day
Cotton irrigation @ 38 in spacing: 1.97 in/day
Establishing pistachios interplanted in Pima cotton using drip tape and saline water. (1st leaf 2 Aug, 2005)
Following stand establishment problems from a cool spring, the saline Well and Blend treatments showed reduced cotton plant height compared to the Aqueduct treatment.

(29 June, 2006)

Belridge Well
EC  5.4 dS/m

Aqueduct
EC  0.5 dS/m

Phytogen 810RR planted 4/12-14/06.
Cotton bed contours of ECe at emergence after ~8 to 10 inches of Aqueduct water for germination.
Pistachio row contours of spring ECe following ~8 to 10 inches (in 6 foot wetted area) of Aqueduct water to refill rootzone.
<table>
<thead>
<tr>
<th></th>
<th>Longest Skip (ft)</th>
<th>Plants /Acre</th>
<th>Lint Yield 10/27/06 (bale/ac)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aque</td>
<td>1.1</td>
<td>33,414</td>
<td>3.67</td>
</tr>
<tr>
<td>Blend</td>
<td>1.4</td>
<td>31,982</td>
<td>3.23</td>
</tr>
<tr>
<td>Well</td>
<td>2.0</td>
<td>29,288</td>
<td>*3.12</td>
</tr>
</tbody>
</table>

*Significantly different @ 0.051 probability.
Aqueduct
EC  0.5 dS/m

Blend (50/50)
EC  3.0 dS/m

Belridge Well
EC   5.4 dS/m

By mid August, vigor in all treatments appeared equal. (17 August, 2006)
### 9-1: 8/14/06 NDVI

<table>
<thead>
<tr>
<th></th>
<th>Aqueduct</th>
<th>Belridge Well</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>EC</strong></td>
<td>0.5 dS/m</td>
<td>5.4 dS/m</td>
</tr>
<tr>
<td><strong>Blend (50/50)</strong></td>
<td>3.0 dS/m</td>
<td></td>
</tr>
<tr>
<td><strong>Belridge Well</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>EC</strong></td>
<td></td>
<td>5.4 dS/m</td>
</tr>
<tr>
<td><strong>Aqueduct</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>EC</strong></td>
<td>0.5 dS/m</td>
<td></td>
</tr>
<tr>
<td><strong>Blend (50/50)</strong></td>
<td></td>
<td>3.0 dS/m</td>
</tr>
</tbody>
</table>
Normalized Difference Vegetation Index

Indicates plant biomass and possibly vigor by the following ratio:

\[ \text{NDVI} = \frac{(\text{NIR}-\text{R})}{(\text{NIR}+\text{R})} \]

NIR = near infrared reflectance @ 800nm
IR = infrared reflectance @ 675nm

*Differences not statistically significant

NDVI comparison after 3 seasons of irrigation treatments
So what about 2008?

9-1 West Compare
4/18/08

Aqueduct
EC 0.5 dS/m

Blend (30% Well, 70% Aque)
EC 2.8 dS/m

Well (60% Well, 40% Aque)
EC 4.7 dS/m
Contours of soil salinity (ECe, dS/m) in pistachio beds after spring preirrigation
Contours of soil saturation paste extract boron (ppm) in pistachio beds after spring pre-irrig
So what about 2008?

Seasonal soil moisture from neutron probe showed no leaching after June.
So what about 2008?

9-1 West Compare
10/18/08

Aqueduct
EC  0.5 dS/m

Blend (30% Well, 70% Aque)
EC  2.8 dS/m

Well (60% Well, 40% Aque)
EC  4.7 dS/m
Select soil first with “Magic Wand” (Tolerance 50) and delete then select green foliage (Tolerance 50) to get total foliage pixel count and “Average Green” (0 is total green, 256 total white)
9-1 West

V2W Well 10/3/07
992,744 pix
73.36 grn mean

V2W Well 10/18/08
1,785,752 pix
89.93 grn mean
V6W
Aque

9-1 West
10/18/08

V4W
Blend

V2W
Well
V6W Aque
1,779,489 pix
74.46 grn mean
(Chroma intensity scale: 0=total black 255=total white)

V4W Blend
1,699,659 pix
81.55 grn mean

V2W Well
1,785,752 pix
89.93 grn mean

9-1 West
Photoshop pixel counts of pistachio foliage
Pistachio foliage pixel counts 10/3/07
So what about 2008?

9-1 West Compare

10/18/08

Aqueduct
EC 0.5 dS/m

Blend (30% Well, 70% Aque)
EC 2.8 dS/m

Well (60% Well, 40% Aque)
EC 4.7 dS/m
# Tissue Analysis for Kerman Leaves

## Kerman Leaves 10/31/06

<table>
<thead>
<tr>
<th></th>
<th>N</th>
<th>P</th>
<th>K</th>
<th>Na</th>
<th>Cl</th>
<th>B</th>
<th>AVG Soil EC 10/30/06</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aque</td>
<td>1.19</td>
<td>0.08</td>
<td>2.67</td>
<td>171</td>
<td>0.52</td>
<td>531</td>
<td>2.65</td>
</tr>
<tr>
<td>50/50</td>
<td>1.36</td>
<td>0.08</td>
<td>2.83</td>
<td>140</td>
<td>*0.58</td>
<td>**954</td>
<td></td>
</tr>
<tr>
<td>Well</td>
<td>*1.55</td>
<td>0.09</td>
<td>2.99</td>
<td>201</td>
<td>*0.62</td>
<td>**1096</td>
<td>*4.61</td>
</tr>
</tbody>
</table>

## Kerman Leaves 6/19/07 (PG1)

<table>
<thead>
<tr>
<th></th>
<th>N</th>
<th>P</th>
<th>K</th>
<th>Na</th>
<th>Cl</th>
<th>B</th>
<th>AVG Soil EC 10/18/07</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aque</td>
<td>2.56</td>
<td>0.14</td>
<td>1.69</td>
<td>99</td>
<td>0.24</td>
<td>167</td>
<td>3.23</td>
</tr>
<tr>
<td>50/50</td>
<td>*2.67</td>
<td>0.14</td>
<td>1.76</td>
<td>108</td>
<td>0.28</td>
<td>**315</td>
<td></td>
</tr>
<tr>
<td>Well</td>
<td>*2.80</td>
<td>0.15</td>
<td>1.75</td>
<td>*133</td>
<td>0.30</td>
<td>**384</td>
<td>*6.53</td>
</tr>
</tbody>
</table>

## Kerman Leaves 10/19/07 (PG1)

<table>
<thead>
<tr>
<th></th>
<th>N</th>
<th>P</th>
<th>K</th>
<th>Na</th>
<th>Cl</th>
<th>B</th>
<th>AVG Soil EC 10/18/07</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aque</td>
<td>1.94</td>
<td>0.15</td>
<td>2.51</td>
<td>98</td>
<td>0.26</td>
<td>342</td>
<td>4.68</td>
</tr>
<tr>
<td>50/50</td>
<td>2.04</td>
<td>0.14</td>
<td>2.71</td>
<td>106</td>
<td>*0.33</td>
<td>**730</td>
<td></td>
</tr>
<tr>
<td>Well</td>
<td>**2.24</td>
<td>0.14</td>
<td>2.76</td>
<td>111</td>
<td>0.30</td>
<td>**915</td>
<td>*5.64</td>
</tr>
</tbody>
</table>

## Kerman Leaves 10/19/07 (UCB1)

<table>
<thead>
<tr>
<th></th>
<th>N</th>
<th>P</th>
<th>K</th>
<th>Na</th>
<th>Cl</th>
<th>B</th>
<th>AVG Soil EC 11/11/08</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aque</td>
<td>1.97</td>
<td>0.13</td>
<td>2.02</td>
<td>82</td>
<td>0.26</td>
<td>253</td>
<td>4.25</td>
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<tr>
<td>50/50</td>
<td>2.01</td>
<td>0.13</td>
<td>2.19</td>
<td>80</td>
<td>0.29</td>
<td>**626</td>
<td></td>
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<tr>
<td>Well</td>
<td>1.97</td>
<td>0.12</td>
<td>2.15</td>
<td>78</td>
<td>0.25</td>
<td>**682</td>
<td></td>
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</table>

## Kerman Leaves 8/26/08 (PG1)

<table>
<thead>
<tr>
<th></th>
<th>N</th>
<th>P</th>
<th>K</th>
<th>Na</th>
<th>Cl</th>
<th>B</th>
<th>AVG Soil EC 4/25/08</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aque</td>
<td>2.29</td>
<td>0.13</td>
<td>2.91</td>
<td>80</td>
<td>0.12</td>
<td>301</td>
<td>2.60</td>
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<tr>
<td>50/50</td>
<td>2.36</td>
<td>0.13</td>
<td>2.87</td>
<td>84</td>
<td>0.12</td>
<td>684</td>
<td>*4.69</td>
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<tr>
<td>Well</td>
<td>2.33</td>
<td>0.13</td>
<td>3.15</td>
<td>79</td>
<td>0.15</td>
<td>**870</td>
<td>*5.64</td>
</tr>
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</table>

## Kerman Leaves 8/26/08 (UCB1)

<table>
<thead>
<tr>
<th></th>
<th>N</th>
<th>P</th>
<th>K</th>
<th>Na</th>
<th>Cl</th>
<th>B</th>
<th>AVG Soil EC 11/11/08</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aque</td>
<td>2.32</td>
<td>0.13</td>
<td>2.41</td>
<td>83</td>
<td>0.14</td>
<td>269</td>
<td></td>
</tr>
<tr>
<td>50/50</td>
<td>2.41</td>
<td>0.13</td>
<td>*2.73</td>
<td>75</td>
<td>0.13</td>
<td>**606</td>
<td></td>
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<tr>
<td>Well</td>
<td>2.37</td>
<td>0.13</td>
<td>2.50</td>
<td>68</td>
<td>0.14</td>
<td>**733</td>
<td></td>
</tr>
</tbody>
</table>
PG1 rootstock growth significantly decreased by 7.4% in Well treatment
Salt added to crop rootzone from start of project

<table>
<thead>
<tr>
<th>Irrigation Treatment</th>
<th>2004 (Cotton)</th>
<th>2005</th>
<th>2006</th>
<th>2007</th>
<th>2008</th>
<th>TOTAL</th>
<th>²EC+ Max</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Irrig (in)</td>
<td>Salt (lb/ac)</td>
<td>Irrig (in)</td>
<td>Salt (lb/ac)</td>
<td>Irrig (in)</td>
<td>Salt (lb/ac)</td>
<td>Irrig (in)</td>
</tr>
<tr>
<td>Aque</td>
<td>32.3</td>
<td>2343</td>
<td>10.4</td>
<td>1742</td>
<td>8.3</td>
<td>1022</td>
<td>12.0</td>
</tr>
<tr>
<td>50/50</td>
<td>33.1</td>
<td>11390</td>
<td>10.4</td>
<td>8570</td>
<td>8.7</td>
<td>8994</td>
<td>10.8</td>
</tr>
<tr>
<td>Well</td>
<td>33.1</td>
<td>21444</td>
<td>11.8</td>
<td>14782</td>
<td>7.9</td>
<td>11104</td>
<td>10.7</td>
</tr>
</tbody>
</table>

¹Irrigation inches for total tree spacing, salt totals (lb/ac) calculated for a 9.5 foot wide subbing area centered on the tree row. Assumes 640 ppm soluble salt = 1 dS/m and a 5 ac-ft depth of soil = 20 million lbs.

²Maximum increase in soil saturated paste EC for a 5 foot rootzone with no precipitation of salts and no leaching past the 5 foot depth.
### Economic Returns from Cotton

<table>
<thead>
<tr>
<th>Cotton</th>
<th>Yield (lb/ac)</th>
<th>Gross $/ac</th>
<th>AQUE Treatment</th>
<th>WELL Treatment</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>Irrig (in)</td>
<td>Salt (lb/ac)</td>
</tr>
<tr>
<td>2004</td>
<td>1959</td>
<td>$1,861</td>
<td>32.3</td>
<td>2,343</td>
</tr>
<tr>
<td>2005</td>
<td>1028</td>
<td>$1,233</td>
<td>31.8</td>
<td>2,305</td>
</tr>
<tr>
<td>Aque'06</td>
<td>1835</td>
<td>$2,019</td>
<td>36.8</td>
<td>1,967</td>
</tr>
<tr>
<td>Well'06</td>
<td>1560</td>
<td>$1,716</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>4821</td>
<td>$5,112</td>
<td>100.9</td>
<td>6,615</td>
</tr>
</tbody>
</table>

**Pistachios 2005-2008**

<p>| | | | | | | | | |</p>
<table>
<thead>
<tr>
<th></th>
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<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Yield (lb/ac)</td>
<td>Gross $/ac</td>
<td>Irrig (in)</td>
<td>Salt (lb/ac)</td>
<td>Net Return</td>
<td>Irrig (in)</td>
<td>Salt (lb/ac)</td>
<td>Net Return</td>
</tr>
<tr>
<td></td>
<td>39.4</td>
<td>8,050</td>
<td>10.3</td>
<td>29.7</td>
<td>73,823</td>
<td>10.3</td>
<td>29.7</td>
<td>73,823</td>
</tr>
</tbody>
</table>

1. Average field yield of all treatments for 2004 & '05 cotton as there was no treatment difference. 2006 yields and returns separated due to treatment effect.
2. Pima price for 2004 - $0.95, 2005 - $1.20, 2006 - $1.10
3. Total applied water, salts and net return based on irrigation + system depreciation cost of $261/ac, $400/ac other cultural/harvest costs and water cost of $120/ac-ft of CA Aqueduct water.
4. Above costs apply except WELL water was $45/ac-ft. The indicated depth of Aqueduct water was used for spring pre-irrigation and germination of cotton.
5. Total applied water and salt load (based on a 9.5 foot wide wetted area) from planting to the end of the 4th year. The $186 net return equals the money saved using the less expensive WELL water.
## Budget Justification for Pistachio/Cotton Saline Irrigation Project

<table>
<thead>
<tr>
<th></th>
<th>2006</th>
<th>2007</th>
<th>2008</th>
<th>2009</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Labor</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SRA II, 0.6 FTE @ $25,992 (’04-5), $28,000 (’06-7)</td>
<td>16,800</td>
<td>16,800</td>
<td></td>
<td></td>
</tr>
<tr>
<td>SRA II, 0.35 FTE @ $29,500 (2009)</td>
<td></td>
<td></td>
<td>11,200</td>
<td>10,325</td>
</tr>
<tr>
<td>Benefits @ 27%</td>
<td></td>
<td>4,536</td>
<td>4,536</td>
<td>3,024</td>
</tr>
<tr>
<td><strong>Equipment/Supplies</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Loggers (6), Watermark blocks, wire, posts @ $700.</td>
<td></td>
<td>4,200</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Auger bit, soil probes, PVC, fittings, gas, misc</td>
<td></td>
<td>500</td>
<td>200</td>
<td>200</td>
</tr>
<tr>
<td>Flowmeters, 16 @ $40</td>
<td></td>
<td>640</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cell phone</td>
<td></td>
<td>100</td>
<td>100</td>
<td>100</td>
</tr>
<tr>
<td>Refurbish pressure chamber, neutron probe parts</td>
<td></td>
<td>1,000</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lab Determinations, 1830 @ $2.00 (’06),</td>
<td></td>
<td>3,660</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2130 @ $2.50 (’07), 1830 @ $2.75 (2008)</td>
<td></td>
<td>5,325</td>
<td>5,325</td>
<td></td>
</tr>
<tr>
<td>1510 @ $3.55 (2009)</td>
<td></td>
<td></td>
<td></td>
<td>5,360</td>
</tr>
<tr>
<td><strong>Travel</strong></td>
<td></td>
<td></td>
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<td></td>
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<tr>
<td>Field work and meetings, 5,000 mi @ $0.48</td>
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<td>2,400</td>
<td>2,400</td>
<td>2,400</td>
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<tr>
<td><strong>Professional services</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pond-Shafter-Wasco RCD Irrigation Mobile Lab</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Irrigation system evaluations, 2 @ $300</td>
<td></td>
<td>600</td>
<td>600</td>
<td>600</td>
</tr>
<tr>
<td>Aerial imaging, 320 acres @ $3.50</td>
<td></td>
<td>1,120</td>
<td></td>
<td>1,120</td>
</tr>
<tr>
<td><strong>ANNUAL TOTALS</strong></td>
<td>30,261</td>
<td>31,081</td>
<td>22,556</td>
<td>20,492</td>
</tr>
<tr>
<td>UC Prosser Trust funding: (2004-5: $59,832)</td>
<td>12,000</td>
<td>12,000</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td><strong>Requested funding from CPRB:</strong></td>
<td>18,261</td>
<td>19,081</td>
<td>22,556</td>
<td>20,492</td>
</tr>
</tbody>
</table>
Conclusions

• Without effective winter rainfall > 6 inches, adequate reclamation for cotton germination is problematic with SDI with tape @ 9” depth when using saline water

• Pistachio growth will be impaired without leaching of 6 to 9 inches of fresh water every 2 to 3 years.

• Presently adsorbed Boron could have a time bomb affect

• Field, tree, budding variability are more significant impacts than irrigation salinity up to 5 dS/m

• Use of saline water could save $2,000 - 10,000/ac over 20 years

• Another 2 to 5 years is required to assess the true sustainability of this system in order …
… to make sure this project doesn’t end up like Paul’s Valentine to his girlfriend!!

Paul’s plan to deliver his Valentine via carrier pigeon goes horribly wrong.