# Water Conservation in the Rio Grande Basin through Efficient Reclaimed Water Use

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# Acknowledgements

RECLAMATION
Managing Water in the West

Rio Grande Basin Initiative
The Texas A&M University System Agriculture Program
RGBI

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# Collaboration

Texas A&M Research Center

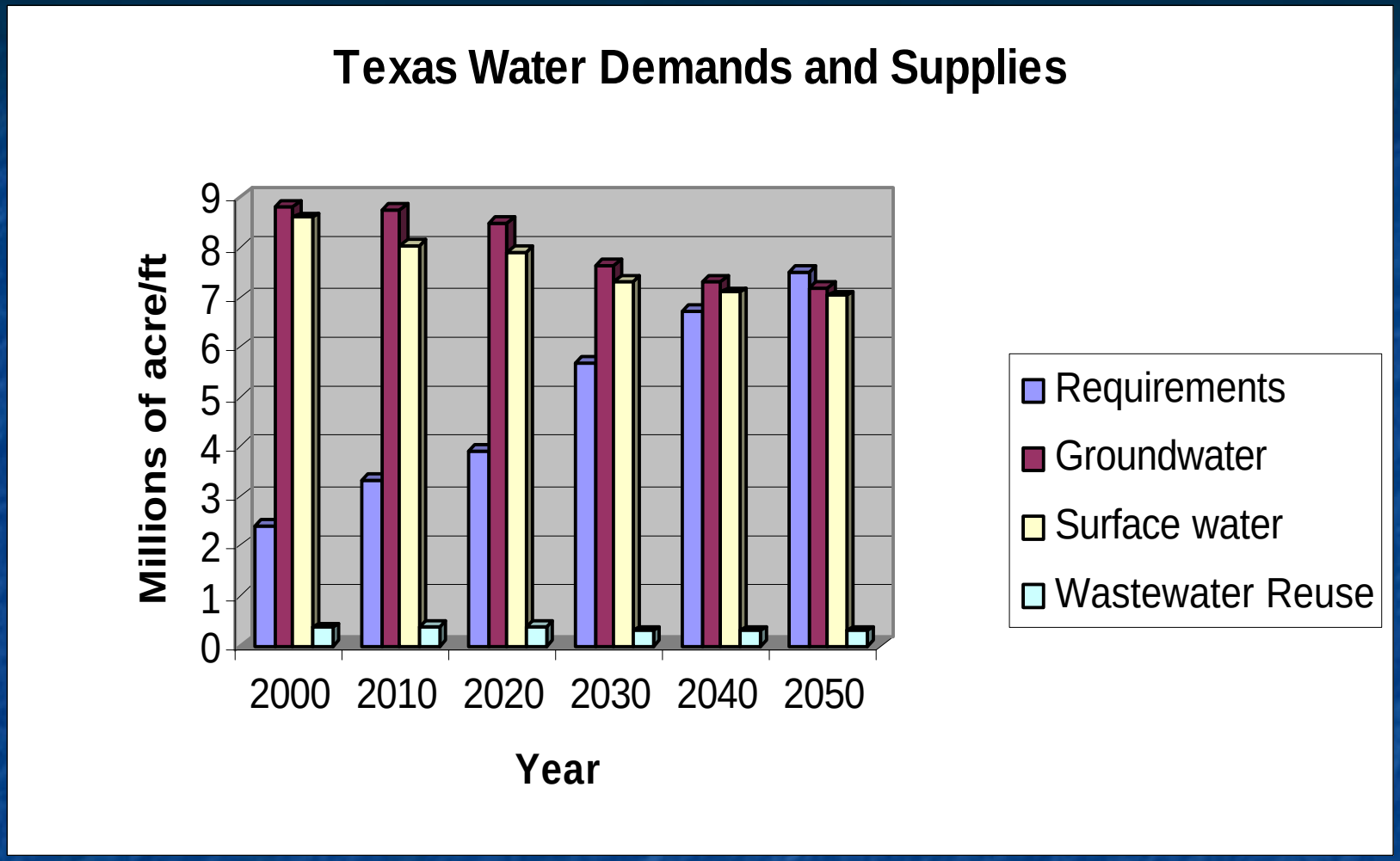
- Ms. Elizabeth Gonzales
- Ms. Lisa Cooper
- Mr. Josh Villalobos
- Dr. Wesley Brown

Rogelio Sanchez State Prison

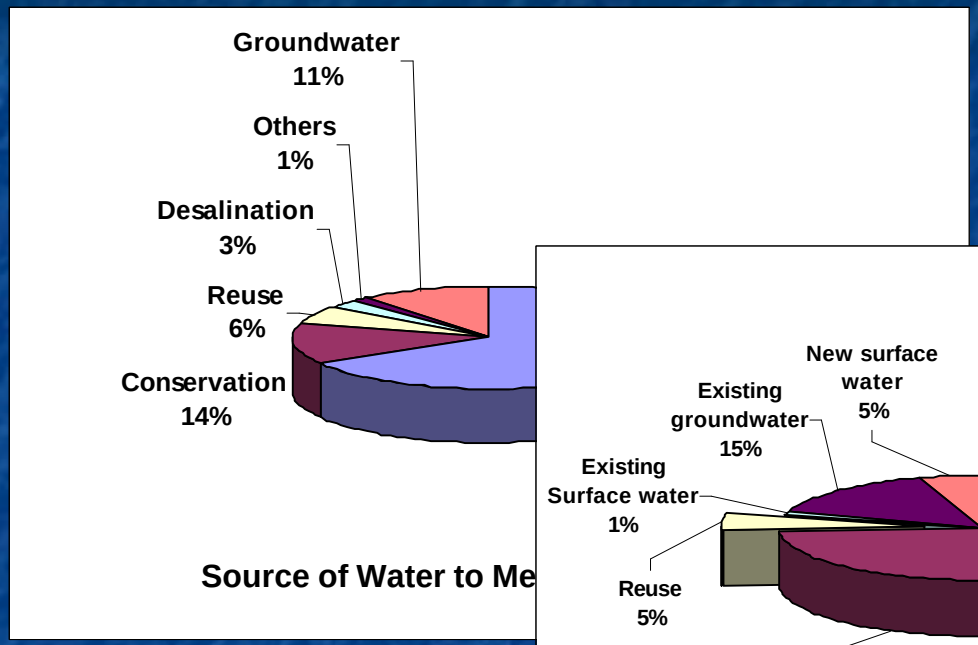
- Sergeant Gibson
- Officer Barnes
- Offenders

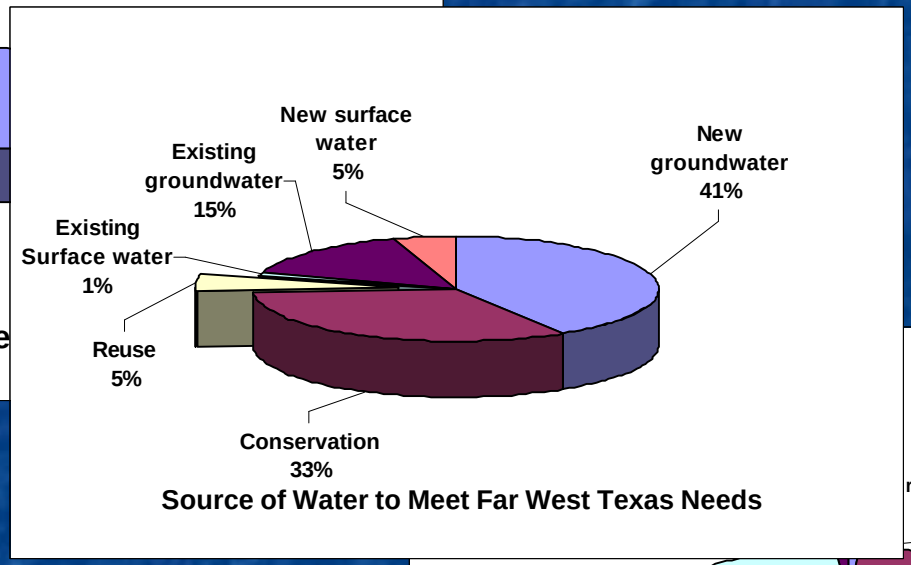
# Presentation Outline

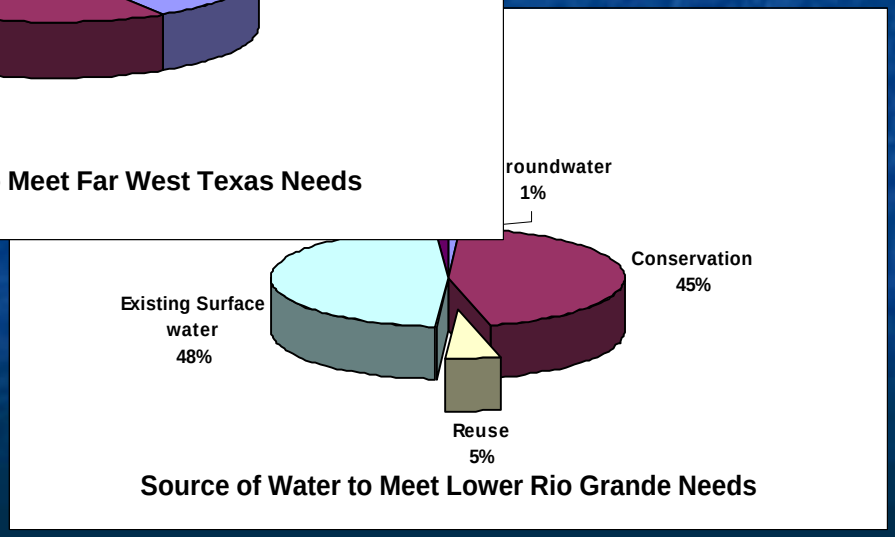
- Background and Ideas
- Objectives
- Experiment
- Results
- Future Plans


Texas Water Demands and Supplies
Millions of acre/ft
0
1
2
3
4
5
6
7
8
9
2000
2010
2020
2030
2040
2050
Year
Requirements
Groundwater
Surface water
Wastewater Reuse

# Sources of Texas Water

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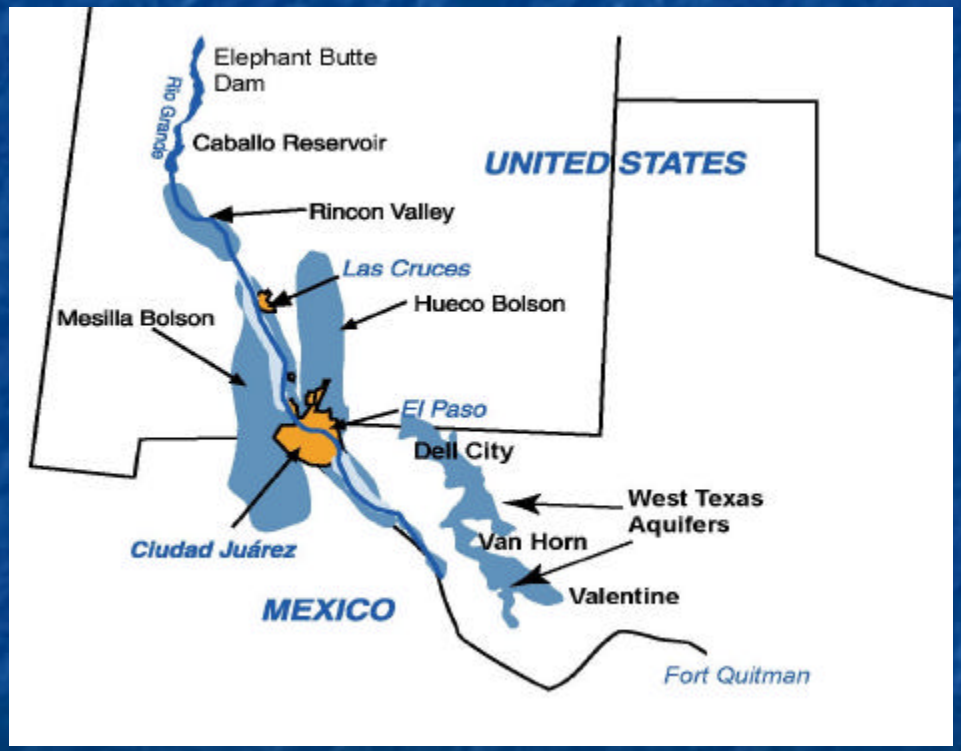
# Texas – Wastewater Reclamation

- About 190 million gallons per day in 1998
- Projected to increase to 27% of the total water demand by 2050
- From municipal WWTP
  - Golf course irrigation
  - Manufacturing
  - Cooling towers
  - In El Paso, highly treated water was also used to recharge the Hueco Bolson (aquifer).

# Paso del Norte Region




- Growing populations
  - El Paso - > 0.7 million
  - Juarez – 1.5 million
- Dependence on groundwater
  - Mining finite fresh water supplies
- Rio Grande
  - 80% for agriculture
- Salt loads typical

# What is Graywater?

- Dilute wastewater, excluding streams from toilets
  - Showers
  - Kitchens
  - Laundry
- up to 68% of total domestic wastewater
- potential to reduce urban potable water demand by up to 30 – 70%
- N and P constituents may be a plus

# Advantages of Graywater Reclamation

- Drought-proof water resource
- Reclaimed water is the only water sources that increases with economic and population growth
- The need for reclamation is close to the source
- Conserves  and protects source waters
- Reduces stress on centralized WWTP

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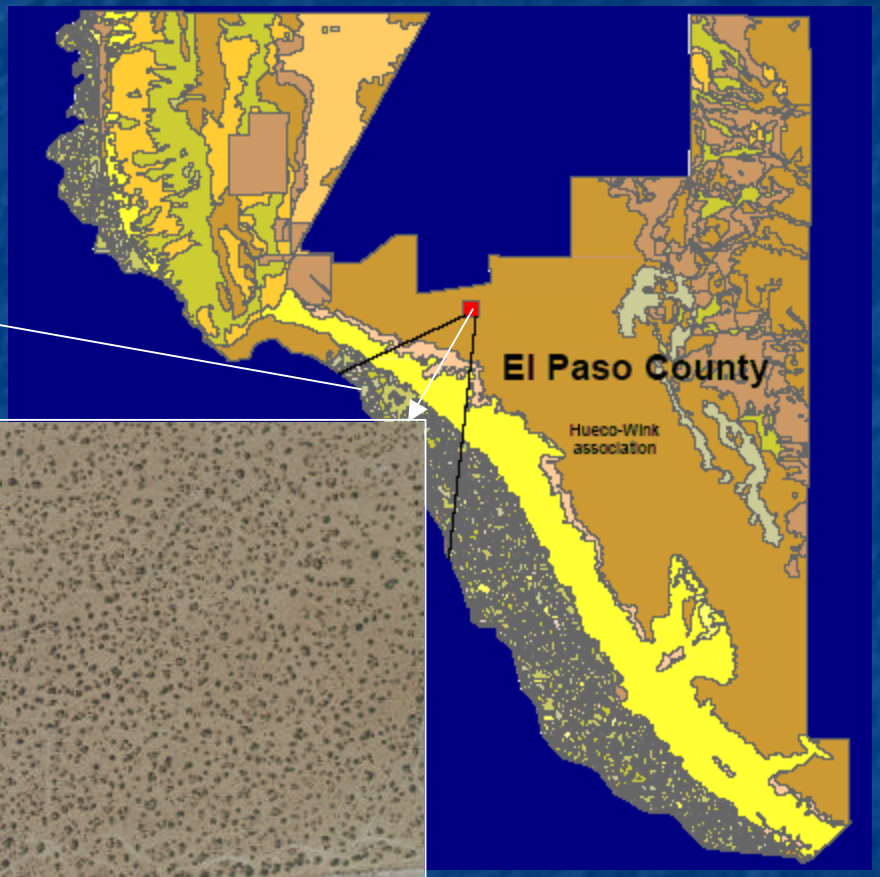
# Salinity – A Primary Concern

- Soaps and detergents increase salinity
- Irrigation water is considered saline when EC = 4 dS $m^{-1}$ or TDS = 2,560 ppm
- Irrigation sources become sodic when SAR > 10 (TAC Chap. 210) or > 13

# Objective

- This study explored the potential for safe and beneficial use of graywater for irrigation.  The benefit of graywater as an irrigation water supply was compared with salty groundwater for vegetable production.

# Non-traditional Site

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# Rogelio Sanchez State Prison

**<u>On a Desert Mesa</u>**

- **Shallow loamy sand underlain with caliche (calcium carbonate)**
- **Rainfall <10 inches**
- **Topsoil from mesquite hummocks placed on plots to a depth of 4 inches**
- **Break shallow caliche pans**

# Laundry and Well Water Irrigation Sources

**<u>Laundry Water</u>– Inside Prison Gates**

**11 loads per day – 3,500 gallon**

**2 wash, 2 rinse, 1 sour bath**

**<u>Salty Well Water</u>**

**Adjacent to the prison**

**<u>Challenge</u>**

**Establish a water delivery system to the demonstration plots**

# Treatments

- Irrigation water sources
  - Prison laundry water
  - Salty well water
- Vegetables
  - Tomatoes
  - Long green chile
  - Bell peppers
- 4 Replications
- Gravity flow irrigation system
  - Stationary tanks
  - PVC Pipe
- Irrigation frequency
  - Every 2 or 3 days
- Moisture sensors
  - 5 and 18 inches below the soil surface
- Beds
  - 3 3 ft x 10 ft rows

# Data Collection

- Salinity (5x)
  - Irrigation Water
  - Surface soil
- Soil Moisture (Cont.)
- *E. coli* (1x)
  - Laundry water
  - Fruit
- Vegetable (3 or 4x)
  - Growth
  - Yields

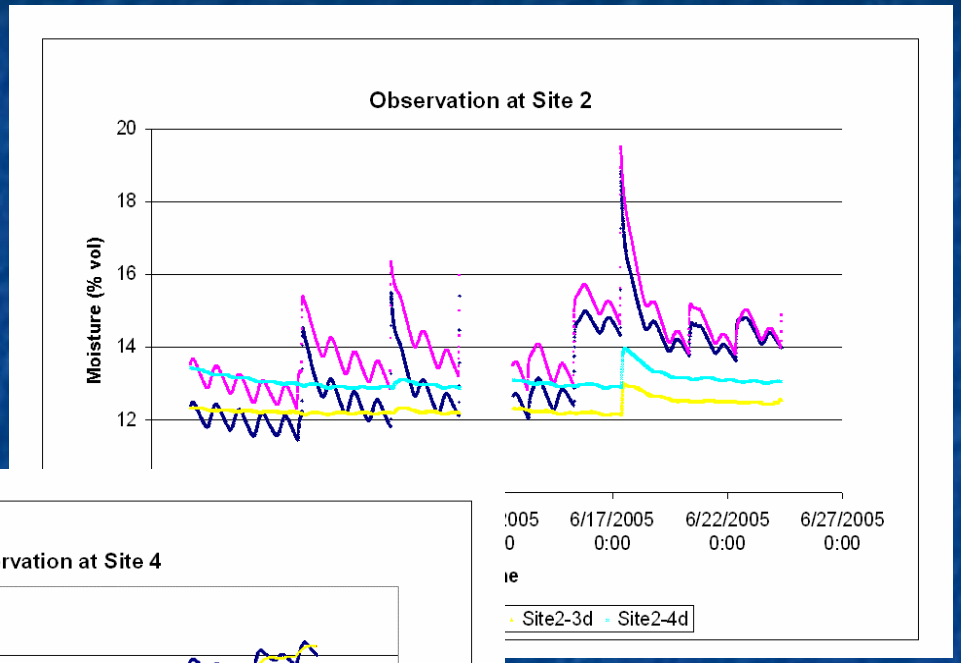
# Local Water Quality Comparisons

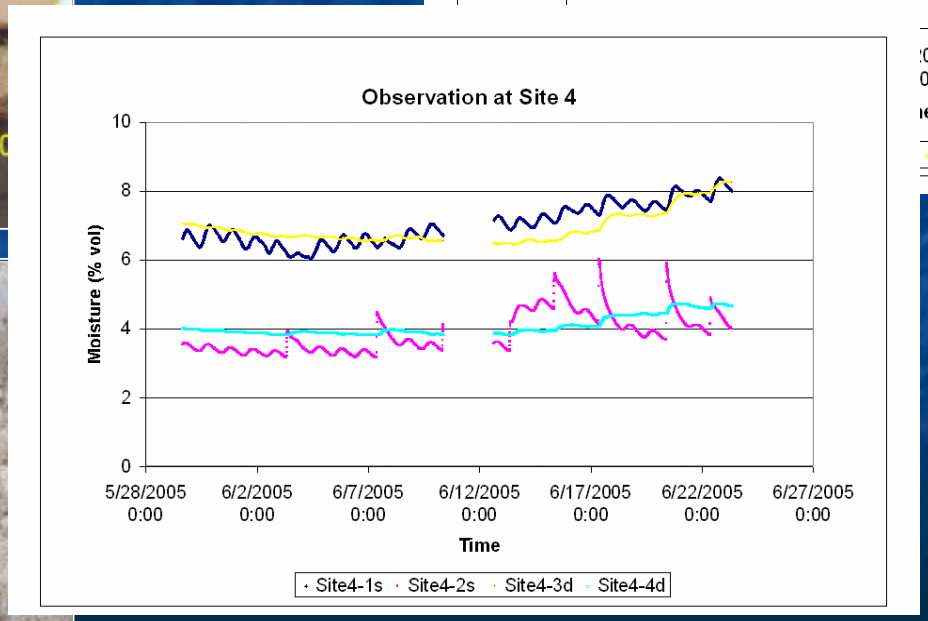
| | Ground water | Gray Water | Desalination Concentrate |
|---|---|---|---|
| pH | 7.8 | 9.2 | |
| EC | 2.6 | 1.7 | 17 |
| TDS | 1,644 | 1,088 | 11,100 |
| Ca | 116 | 26 | 1394 |
| Mg | 24 | 2 | 859 |
| Na | 521 | 410 | 870 |
| Cl | 423 | 217 | 6357 |
| SO4 | 689 | 311 | 1620 |
| NO3 | -- | -- | -- |
| PO4 | -- | -- | -- |
| SAR | 11.5 | 21.0 | 4.5 |

| Chemical Parameter | |
|---|---|
| pH | 8.3 |
| EC[1] (dS $m^{-1}$) | 1.02 |
| Available Ca (mg $kg^{-1}$) | 98.6 |
| Available Mg (mg $kg^{-1}$) | 31.4 |
| Available Na (mg $kg^{-1}$) | 115 |
| SAR[2] | 12.4 |
| Total N (mg $kg^{-1}$) | 335.9 |
| $NO_3$-N (mg $kg^{-1}$) | 7.2 |
| NH4-N (mg $kg^{-1}$) | 4.8 |
| $PO_4$-P (mg $kg^{-1}$) | 23.6 |

# Soil Characteristics prior to planting

# Soil Moisture



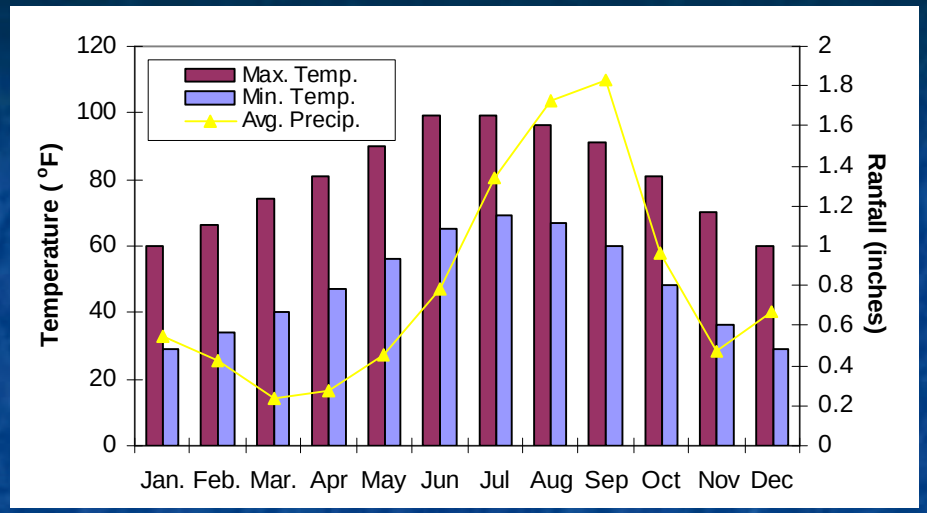
# Vegetables

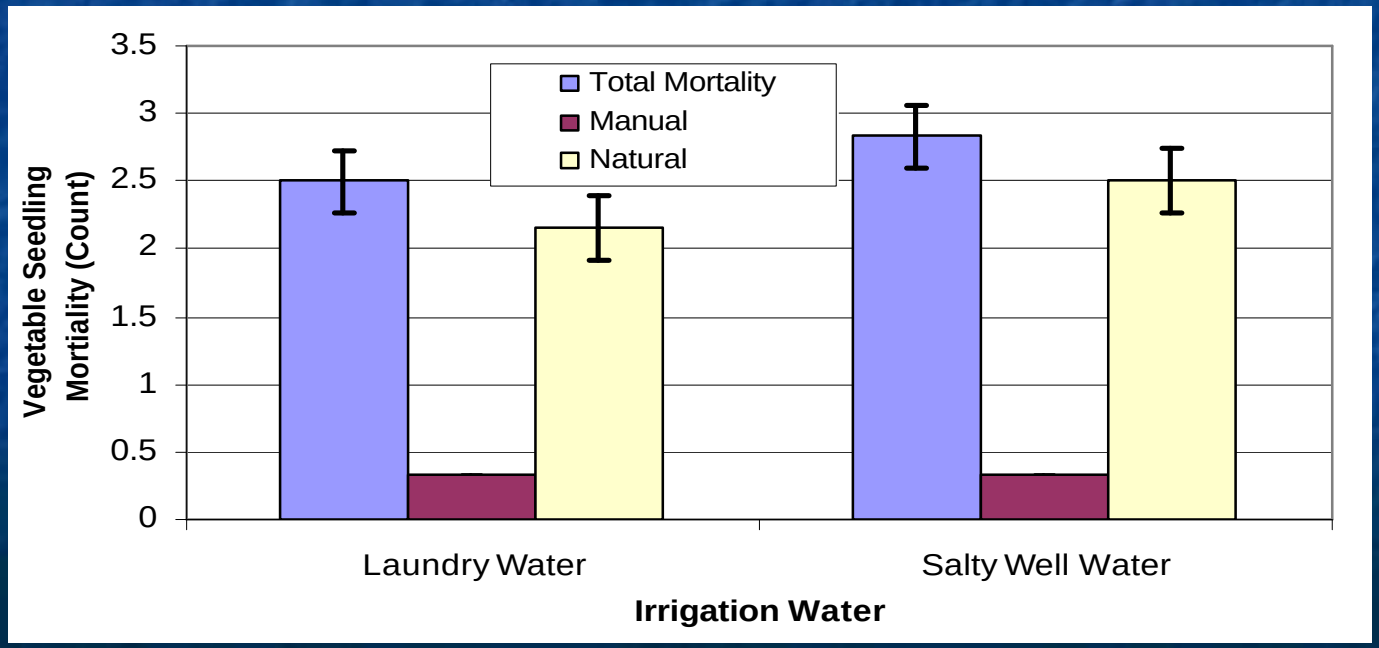
May 3 – delayed due to prison lock-up

Insured water flow

Stand establishment good, given curly top virus

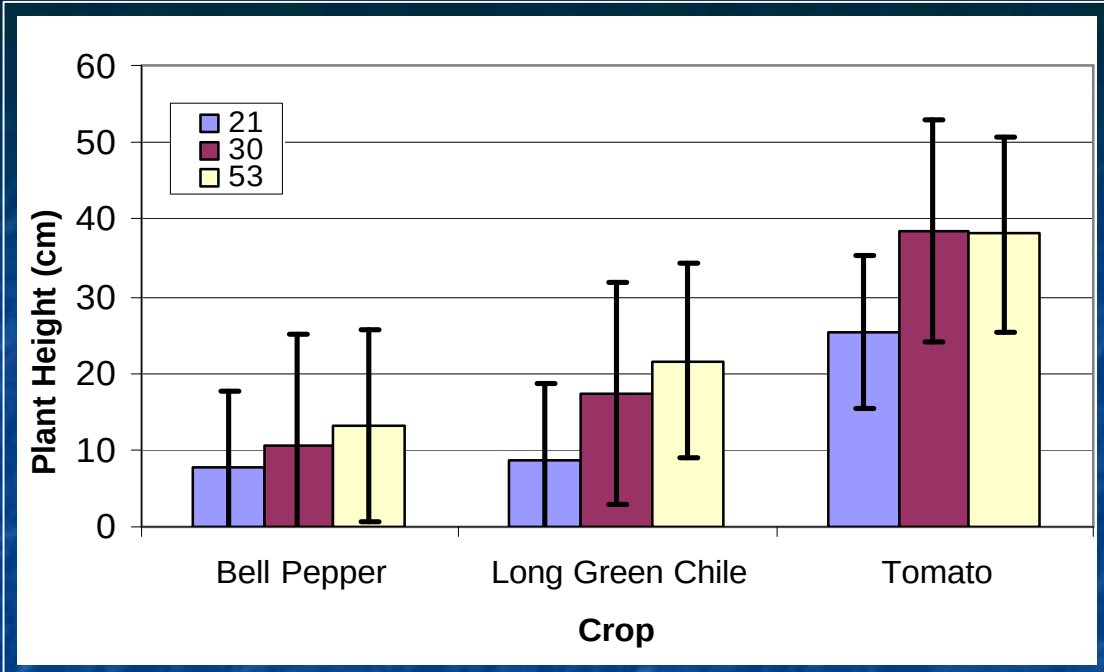
05/04/2005

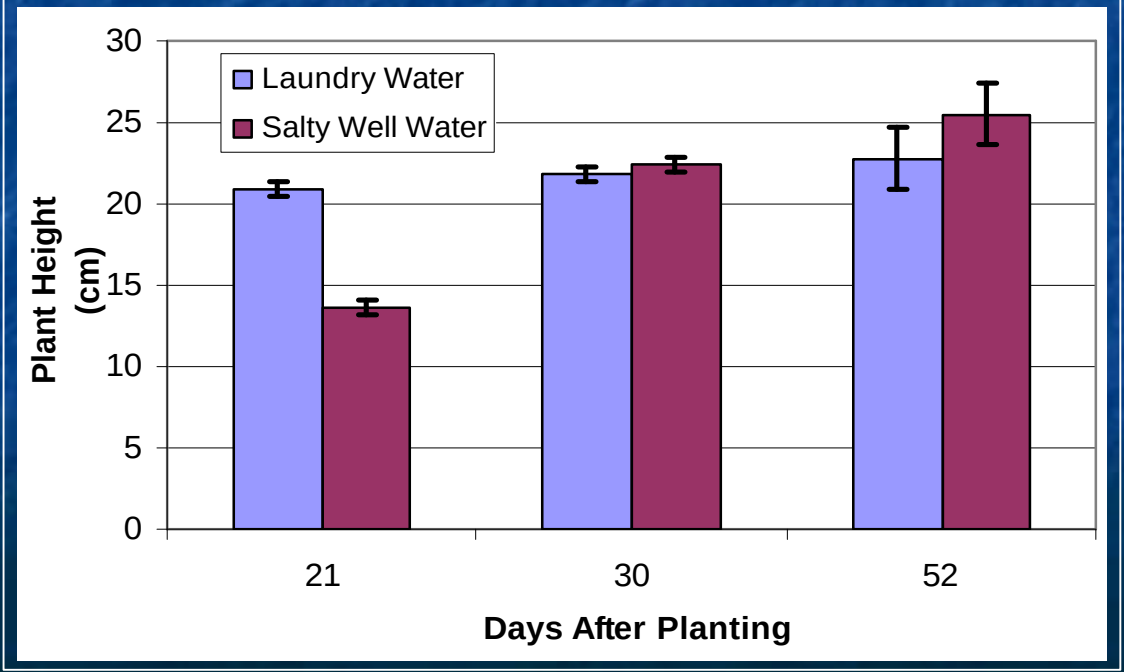

Max. Temp.
Min. Temp.
Avg. Precip.
Temperature (°F)
Ranfall (inches)
120
100
80
60
40
20
0
2
1.8
1.6
1.4
1.2
1
0.8
0.6
0.4
0.2
0
Jan. Feb. Mar. Apr May Jun Jul Aug Sep Oct Nov Dec


Total Mortality
Manual
Natural
Vegetable Seedling Mortiality (Count)
3.5
3
2.5
2
1.5
1
0.5
0
Laundry Water
Salty Well Water
Irrigation Water

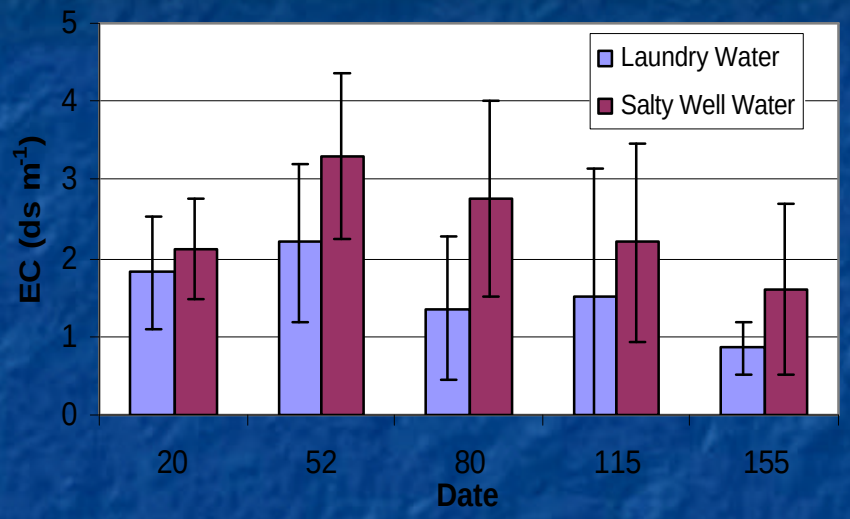
06/21/2005

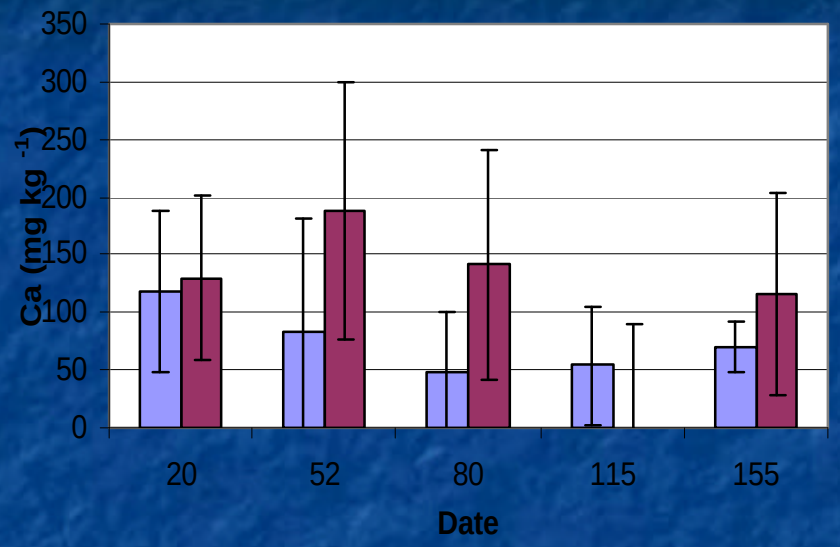
07/22/2005

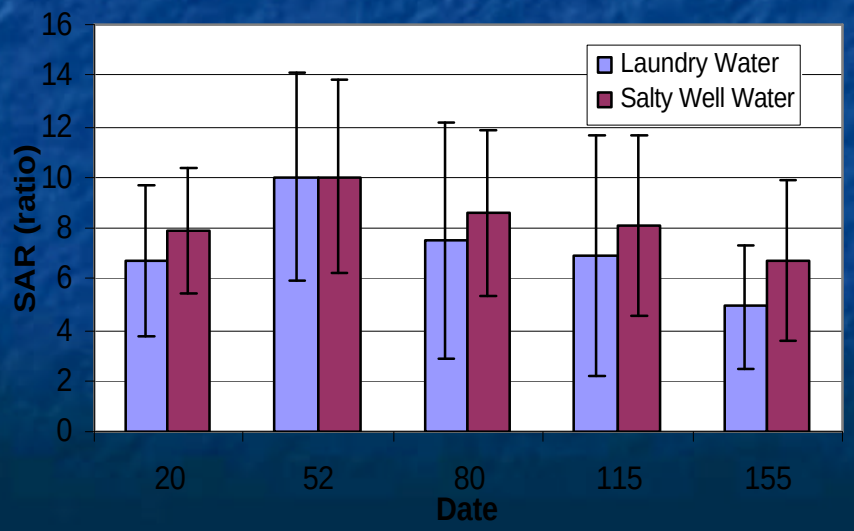

60
50
40
30
20
10
0
Plant Height (cm)
21
30
53
Bell Pepper
Long Green Chile
Tomato
Crop

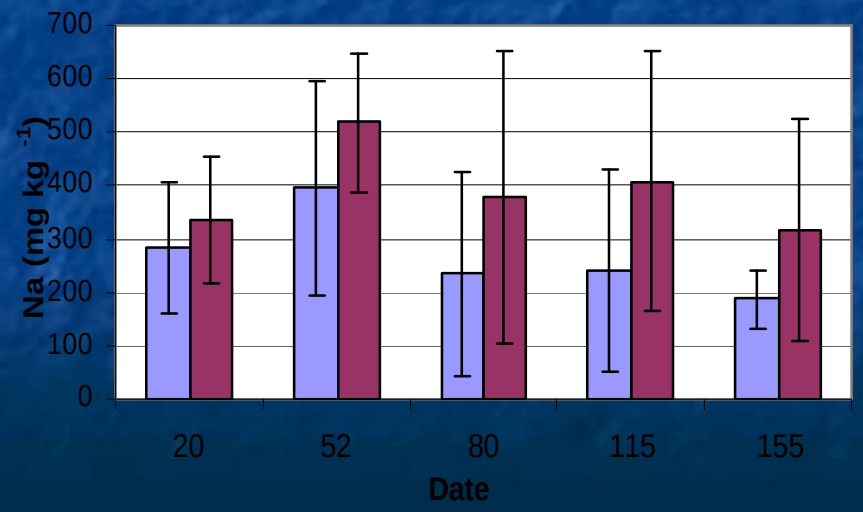

30
25
20
15
10
5
0
Plant Height (cm)
Laundry Water
Salty Well Water
21
30
52
Days After Planting

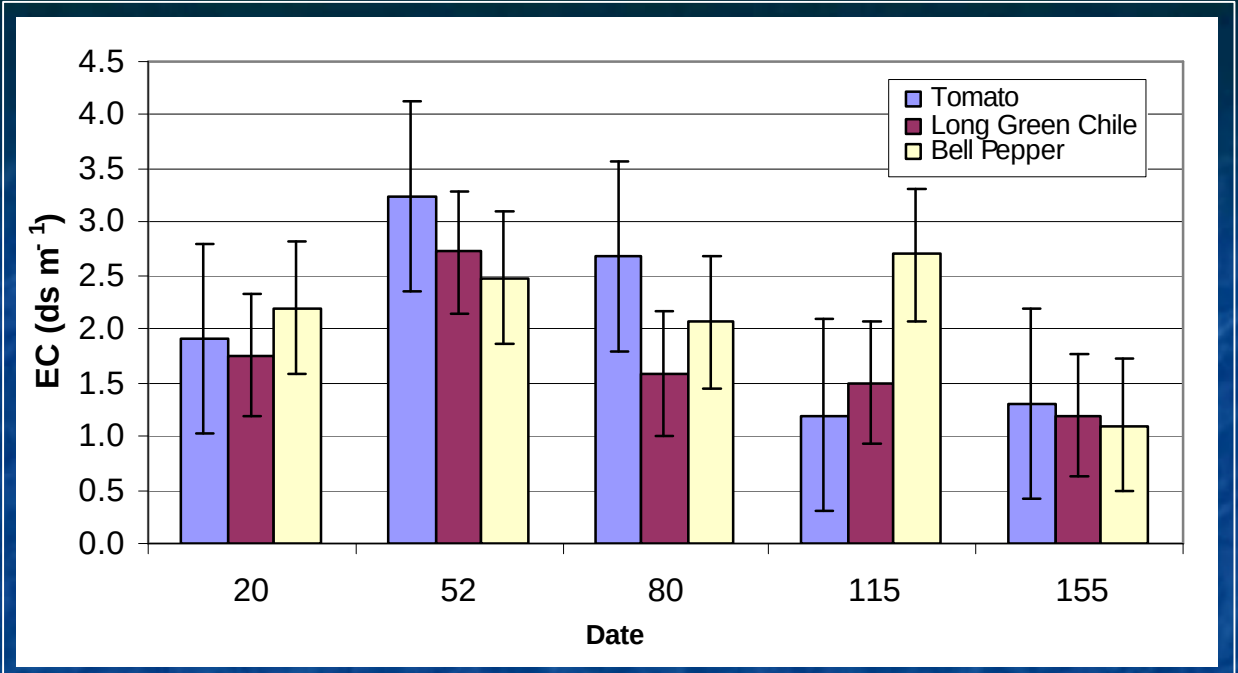
# Soil Salinity and Sodicity

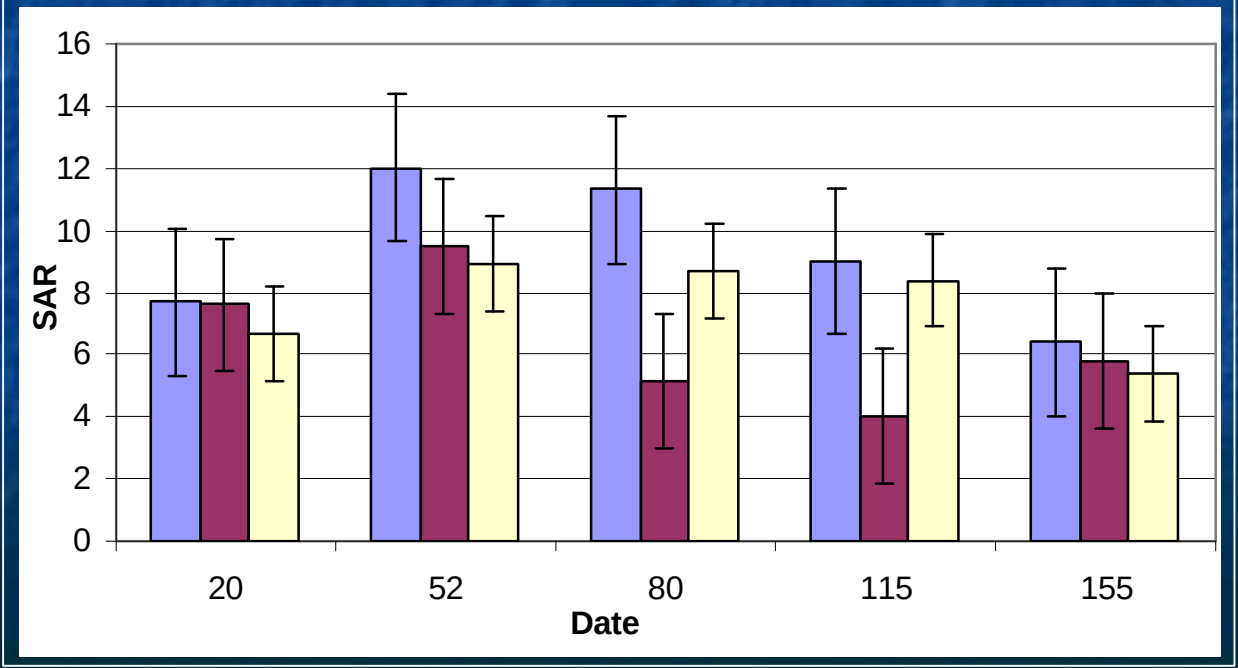


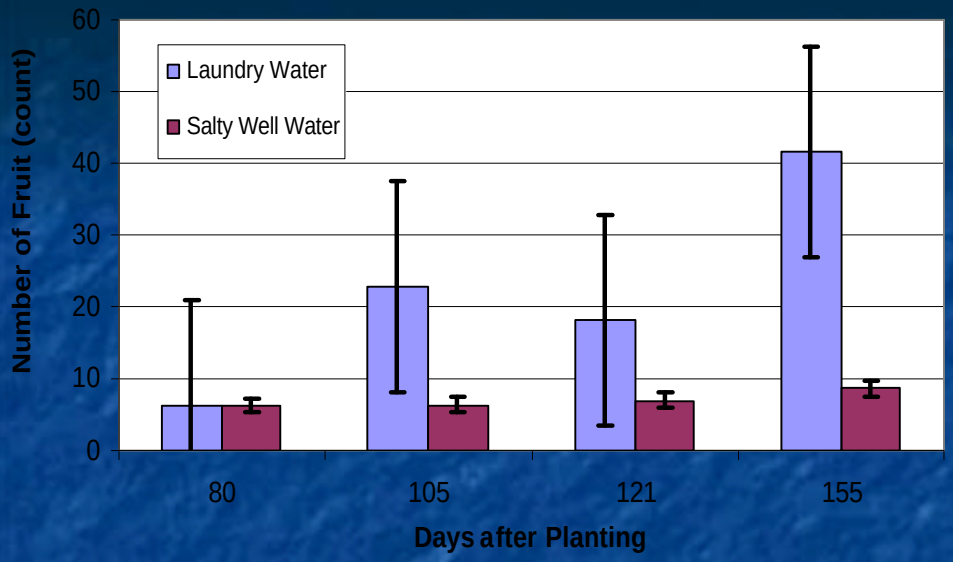

4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
EC (ds m-1)
Tomato
Long Green Chile
Bell Pepper
20
52
80
115
155
Date

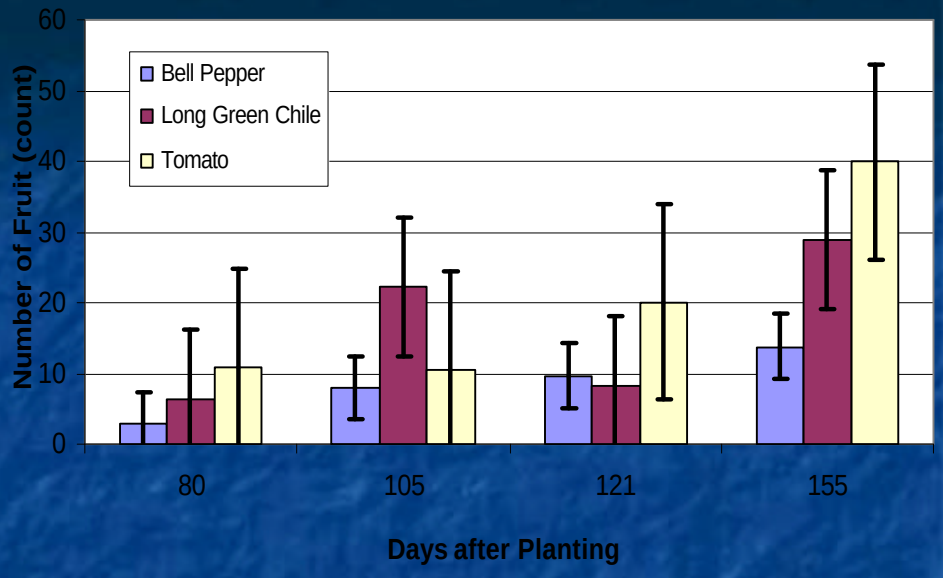

16
14
12
10
8
6
4
2
0
SAR
20
52
80
115
155
Date

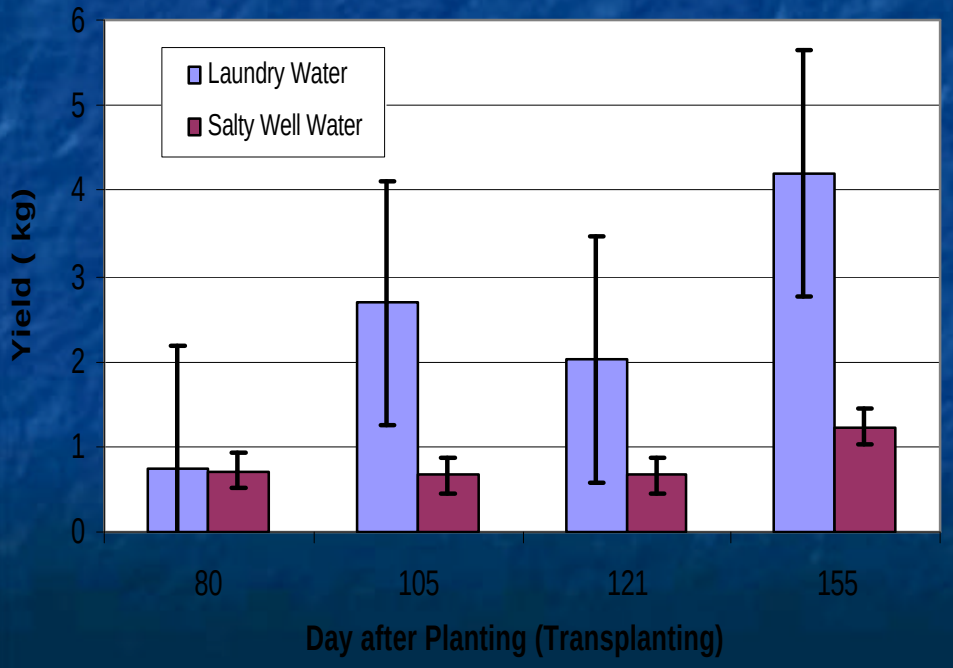
# Microbial Contamination using *E. coli*

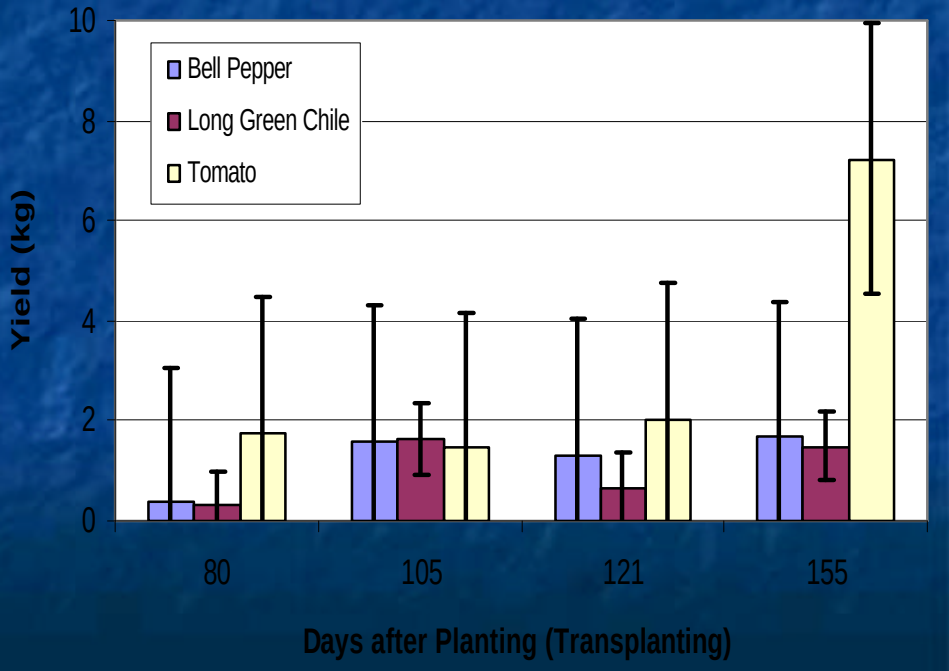
- Laundry Water
  - **No** *E. coli* from water collected from the trap
  - Potential to support E. coli when seeded
- Fruit Surfaces
  - **No** *E. coli* cultured from swabs of fruit surfaces

# Vegetable Yields


Laundry Water
Salty Well Water
Number of Fruit (count)
0
10
20
30
40
50
60
80
105
121
155
Days after Planting


Bell Pepper
Long Green Chile
Tomato
Number of Fruit (count)
0
10
20
30
40
50
60
80
105
121
155
Days after Planting


Laundry Water
Salty Well Water
Yield ( kg)
0
1
2
3
4
5
6
80
105
121
155
Day after Planting (Transplanting)


Bell Pepper
Long Green Chile
Tomato
Yield (kg)
0
2
4
6
8
10
80
105
121
155
Days after Planting (Transplanting)

# Conclusions

- Graywater was a good irrigation source
  - Lower salt load than well water
  - Contained P
- No leaching of salts
- No salt and Na accumulation in surface soil
- No E. coli detection in graywater or fruit surfaces
- Laundry water irrigation significantly increased yields in comparison to well water irrigation

# Future Work

- Continue the field study for 2 more years
- Challenge TAC Chapter 210 guidelines on irrigation water SAR
- Provide evidence that salsa using vegetables from the demonstration garden can be safely consumed

# Thank You

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