Reducing Economic and Environmental Associated Risks of Tomato Production Using Irrigation and Nutrient BMP


Photo credit: I.T. Ayankojo

I.T. Ayankojo & K.T. Morgan
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Introduction

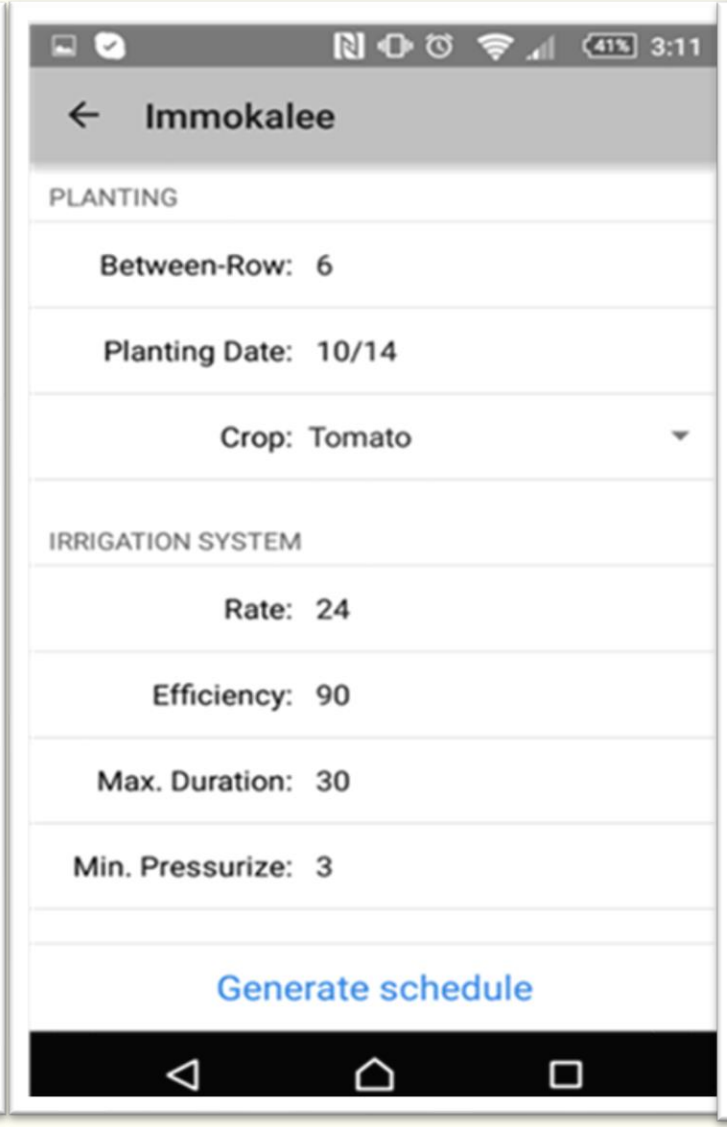
- Nutrient management is a key aspect of vegetable production
- Efficient nutrient management can improve yield and fruit quality
- Irrigation scheduling methods and/or irrigation application rate are critical for an efficient nutrient management
- Excessive irrigation application may result in negative economic and environmental consequences

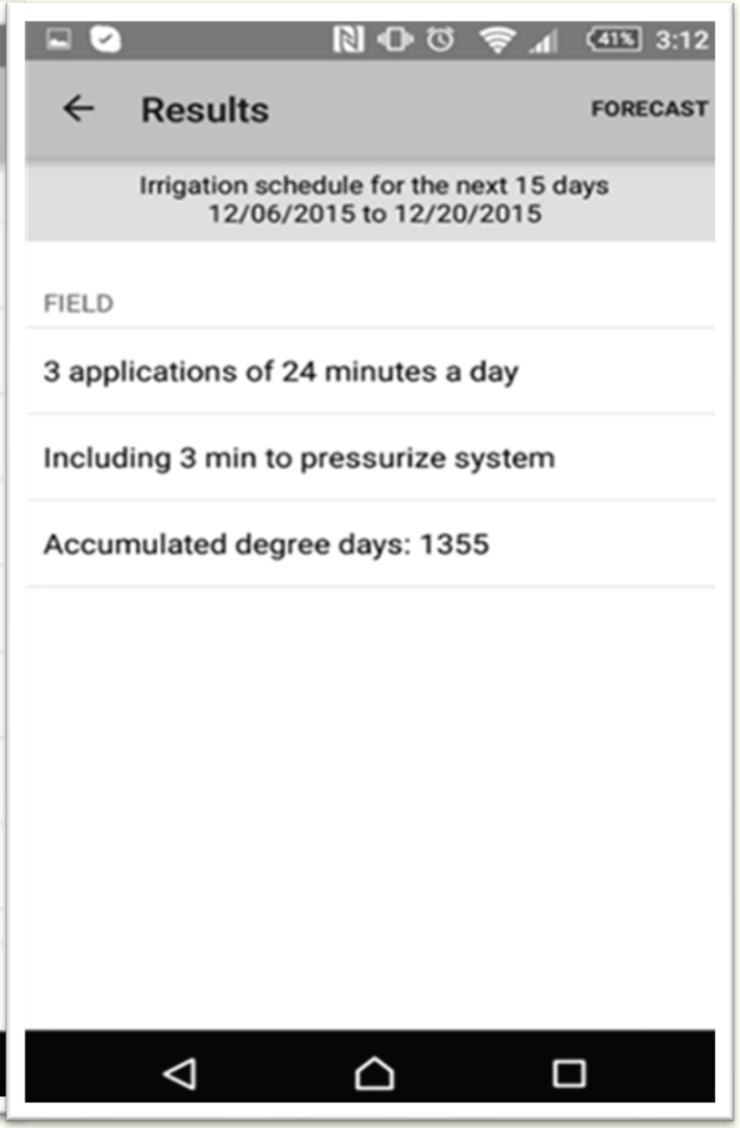
Objectives

- Overall goal is to reduce both economic (yield factor) and environmental (water, nutrient factors) associated risks in tomato production using best management practices (BMP).

  - Evaluate an alternative irrigation scheduling method (SmartIrrigation Veg. App) in tomato production
  - Evaluate the effects of combined irrigation and nitrogen rates on general crop performance
  - Determine the impact of modified irrigation and nitrogen timing in tomato production
  - Evaluate an alternative bedding system for both nutrient and water conservation in tomato crop.

What is SI Vegetable App?





Other SI Apps available for use

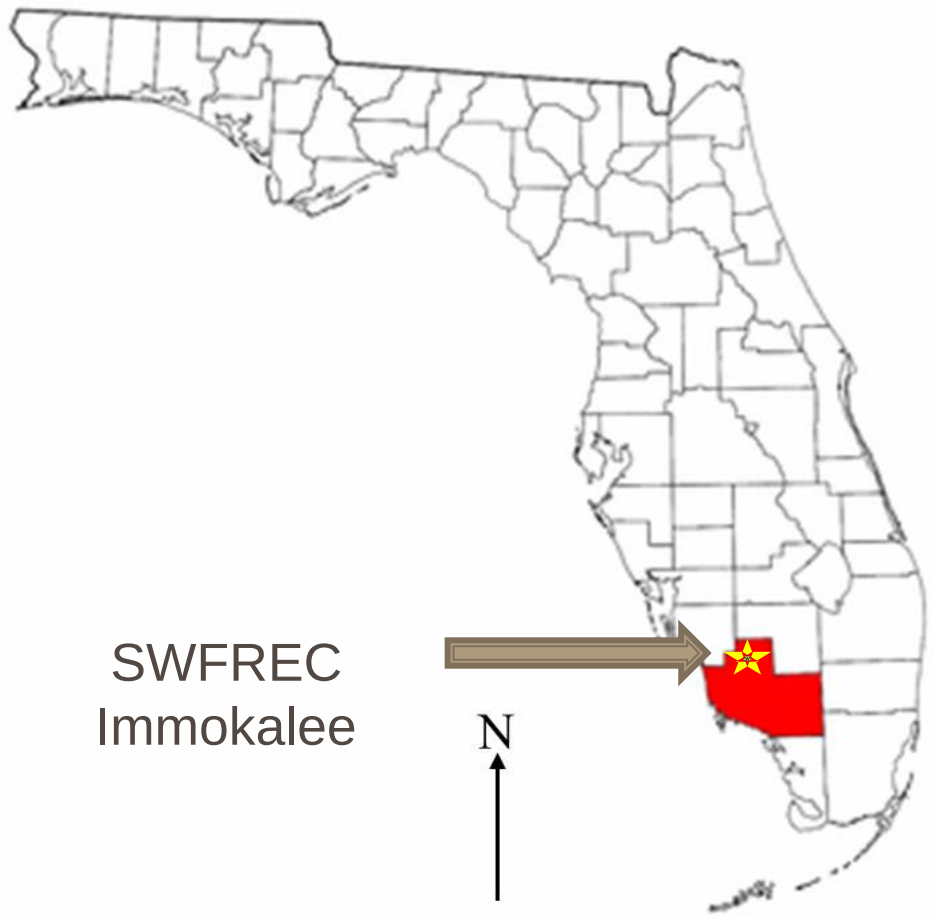
Any of these Apps can be downloaded for free on your smartphone from both iOS and Android platforms

Joint efforts by

- UF/IFAS
- USDA NIFA
- University of Georgia

For more information please visit <http://smartirrigationapps.org/>

Study location



All the experiments
in this presentation were
conducted
at SWFREC, Immokalee
experimental field

Materials and Methods: Pre- and post-planting practices

- Nutrient and irrigation management may change for different studies
- Drip irrigation was used during all studies

All pre- and post-planting operations followed the growers standard

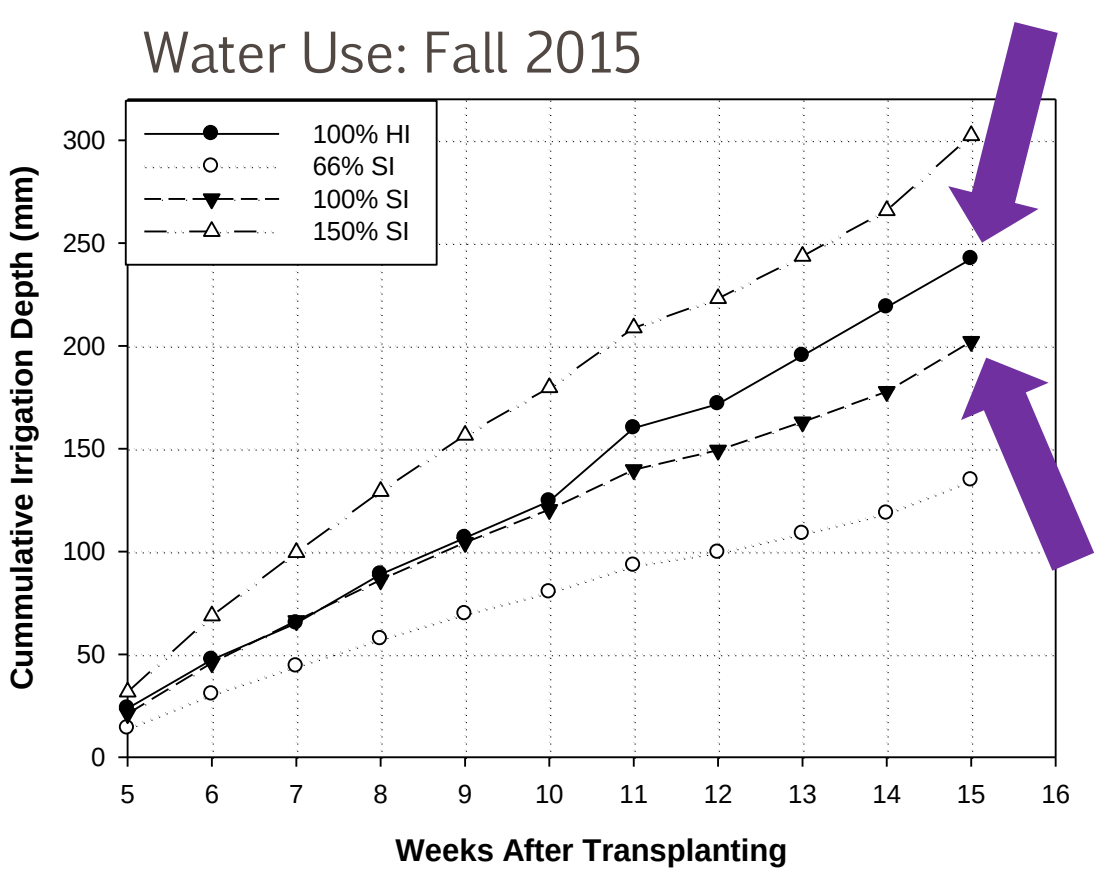
- Fumigation
- Bedding and bed size
- Planting and planting density
- Crop protection and harvesting

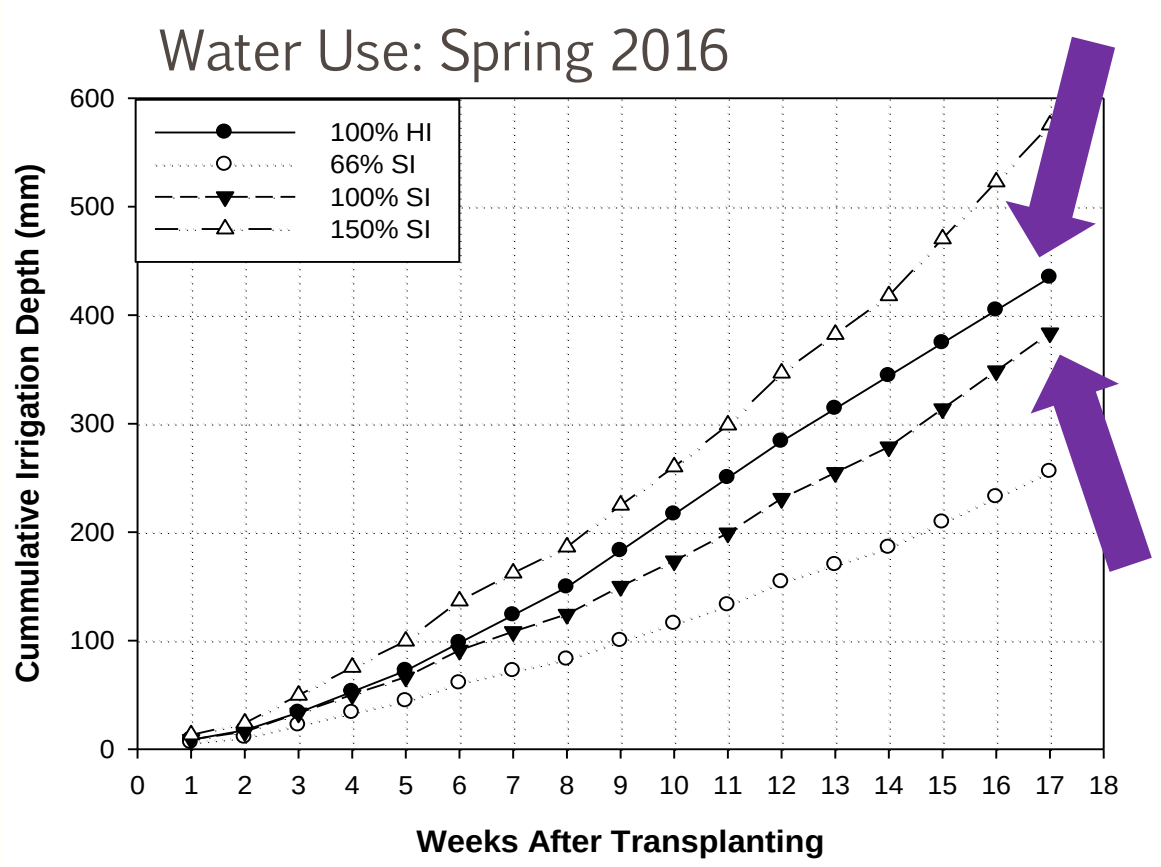
Study #1: Irrigation Scheduling Methods (Fall ‘15 & Spring ‘16)

Treatment ID	Total N (lb A^{-1})	Detail
T1	200	Irrigation 100% IFAS (HI, Grower Standard)
T2	200	Irrigation 66% App (66% SI)
T3	200	Irrigation 100% App (100% SI)
T4	200	Irrigation 150% App (150% SI)

Study #1: Result water use

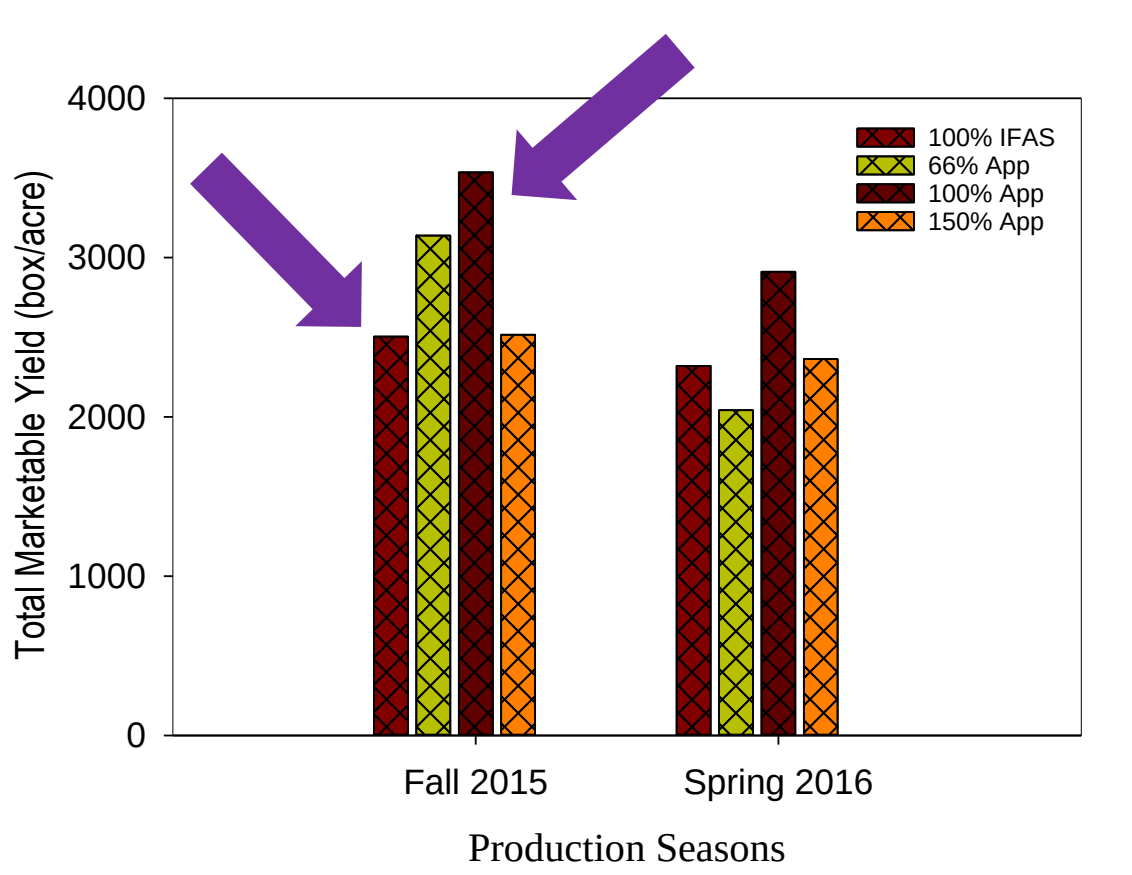
Grower's standard (HI) vs SmartIrrigation Veg. App (SI)





- Water use was 20% (fall) and 17% (spring) lower for 100% SI compared to 100% HI
- This may translate in reduction in water pumping cost

Results: Yield

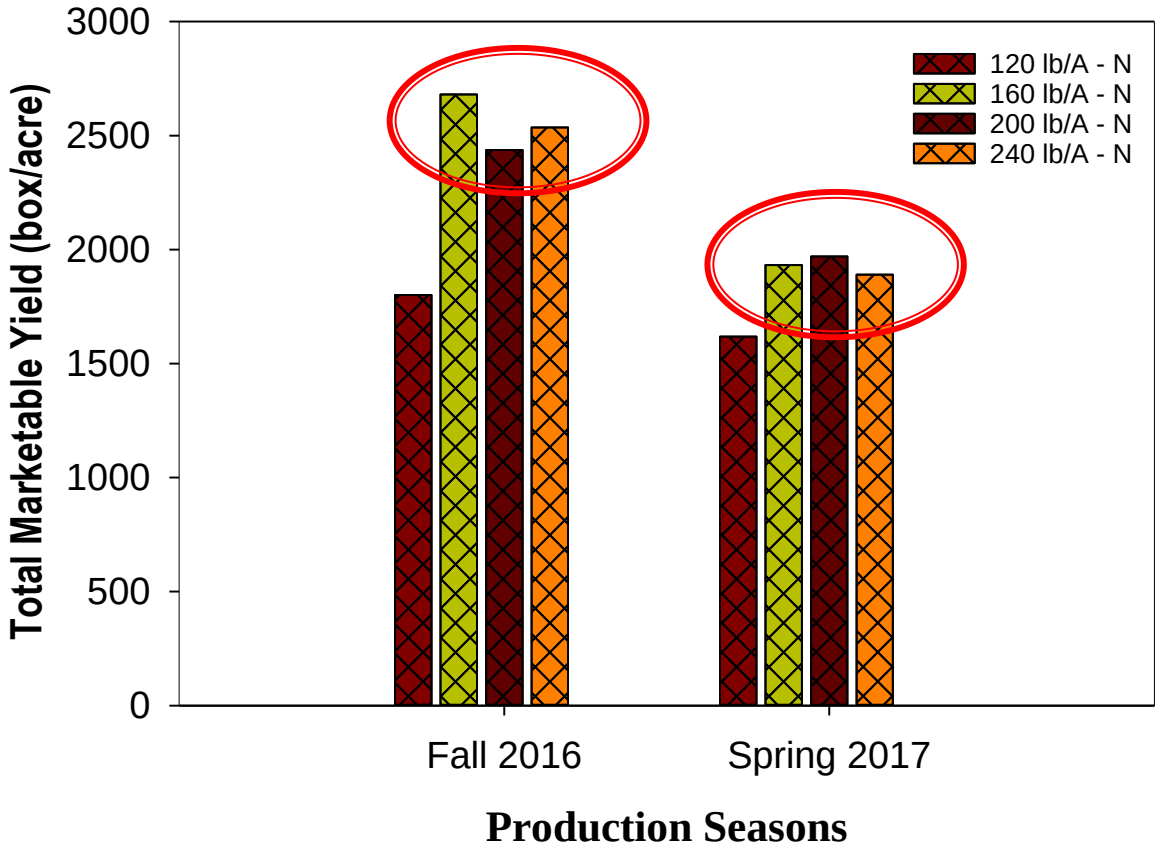


- All treatments received 200 lb per acre N
- SI Veg. App increase tomato yield compared to the growers standard irrigation method
- Irrigation at 100% App rates maintained nutrient at tomato root zone hence reduce nutrient leaching

Study #2: Combined irrigation and nitrogen rates (Fall ‘16 & Spring ‘17)

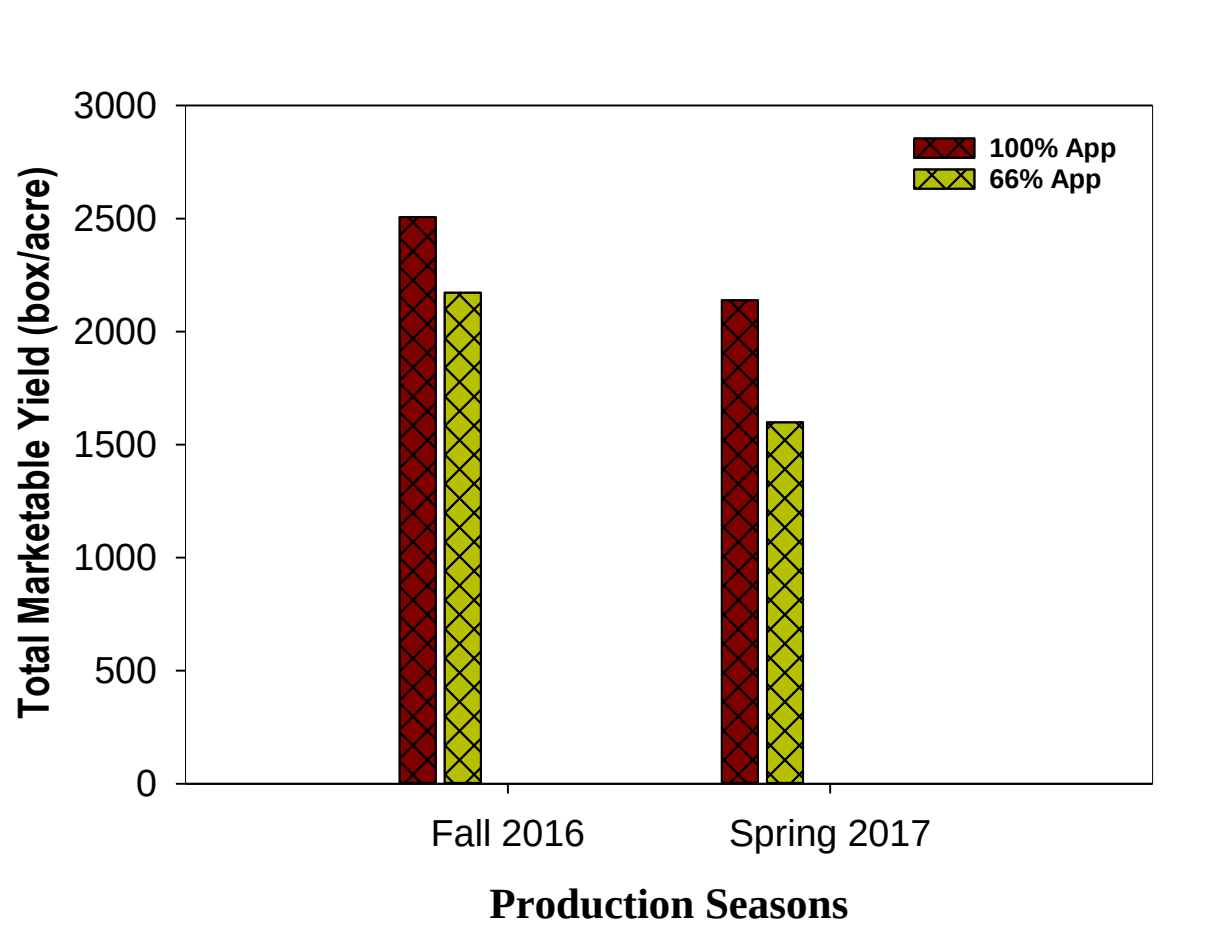
Treatment ID	Total N (lb A^{-1})	Detail
T1	120	Irrigation 100% App and Nitrogen 60%
T2	160	Irrigation 100% App and Nitrogen 80%
T3	200	Irrigation 100% App and Nitrogen 100%
T4	240	Irrigation 100% App and Nitrogen 120%
T5	120	Irrigation 66% App and Nitrogen 60%
T6	160	Irrigation 66% App and Nitrogen 80%
T7	200	Irrigation 66% App and Nitrogen 100%
T8	240	Irrigation 66% App and Nitrogen 120%

Results: Yield – Nitrogen rates



- N application rate above 160 lb/A does not increase tomato yield under an efficient irrigation management
- Lower but efficient N application can reduce production cost
- High N application rate can increase leaching and reduce N use efficiency

Results: Yield – Irrigation rates



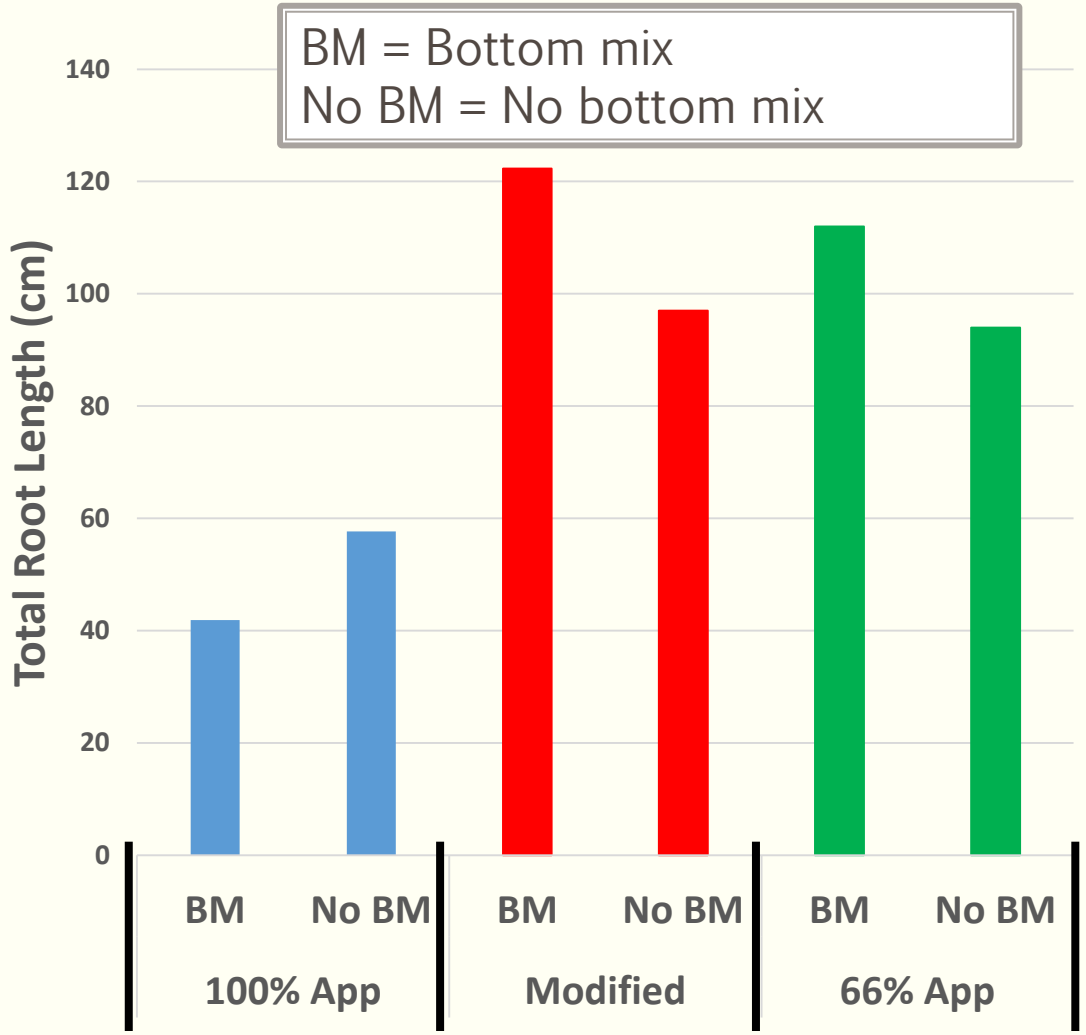
- Irrigation rates at 100% App increase tomato yield irrespective of N application rate
- Low irrigation application rate throughout the production season can cause plant stress and reduce tomato yield especially during the spring season

Study #3: Modified irrigation and N timing (Spring ‘18 & Fall ‘18)

Treatment ID	Total N (lb A^{-1})	Detail
T1	200	Irrigation 100% App and Bottom mix
T2	200	Irrigation 100% App and No bottom mix
T3	200	Modified irrigation and Bottom mix
T4	200	Modified irrigation and No bottom mix
T5	200	Irrigation 66% App and Bottom mix
T6	200	Irrigation 66% App and No bottom mix

Note: Modified irrigation = 66% App early in the season and 100% App from about 6 weeks after transplanting (6 WAT)

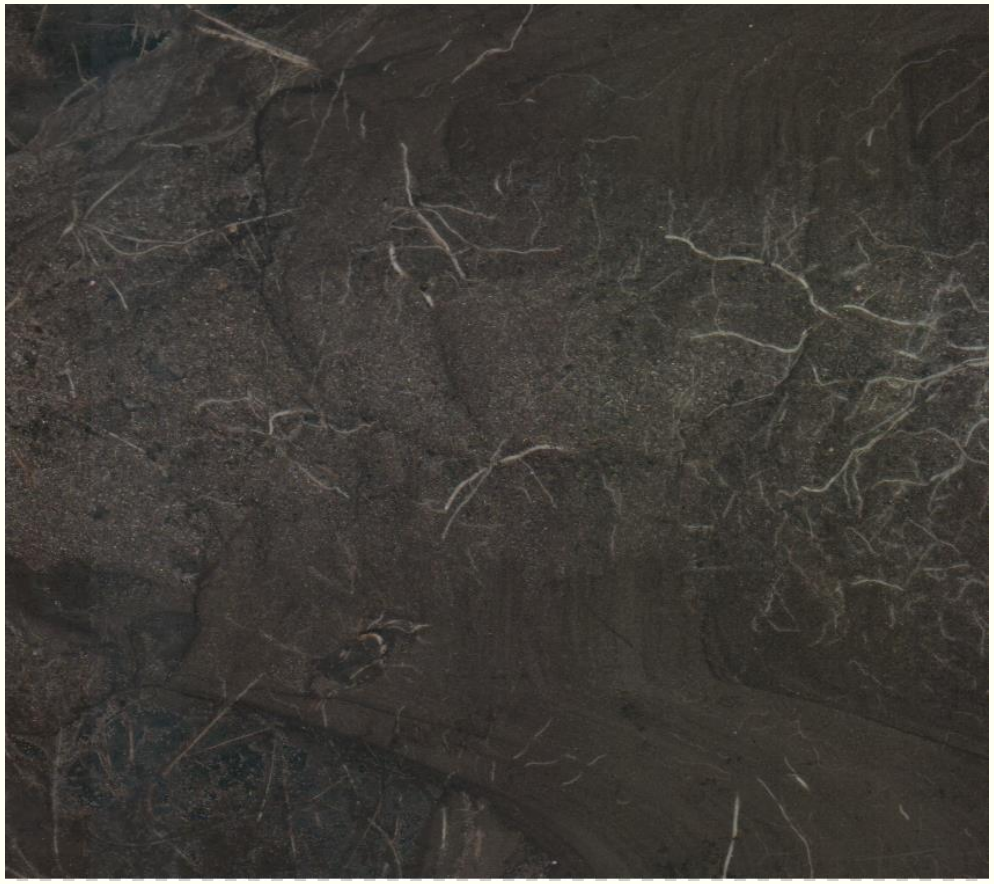
Results: Total Root Length at Crop Growth Stage 3



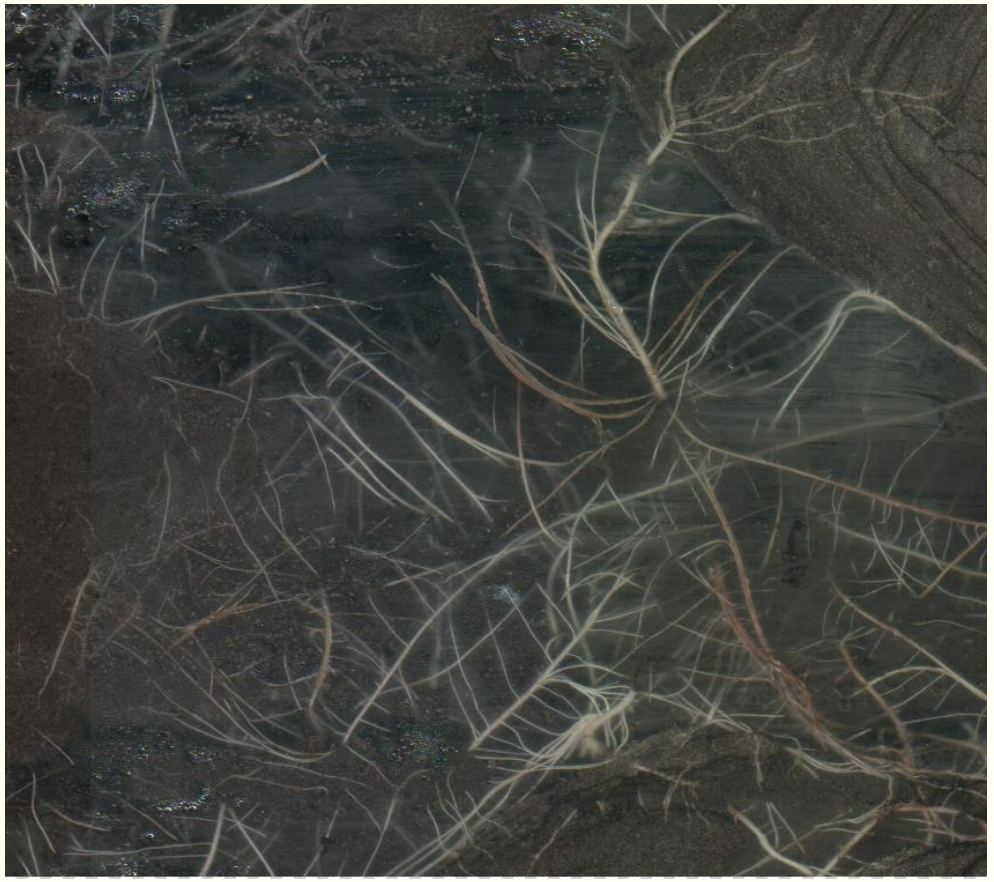
- Lower irrigation rate early in the production season increase tomato root production
- Increase in root production does not reduce plant biomass production
- Greater root production can improve water and nutrient uptake hence, yield increase

Results: Total root length at crop growth stage 3 (6 WAT)

Full water rate (100% App)

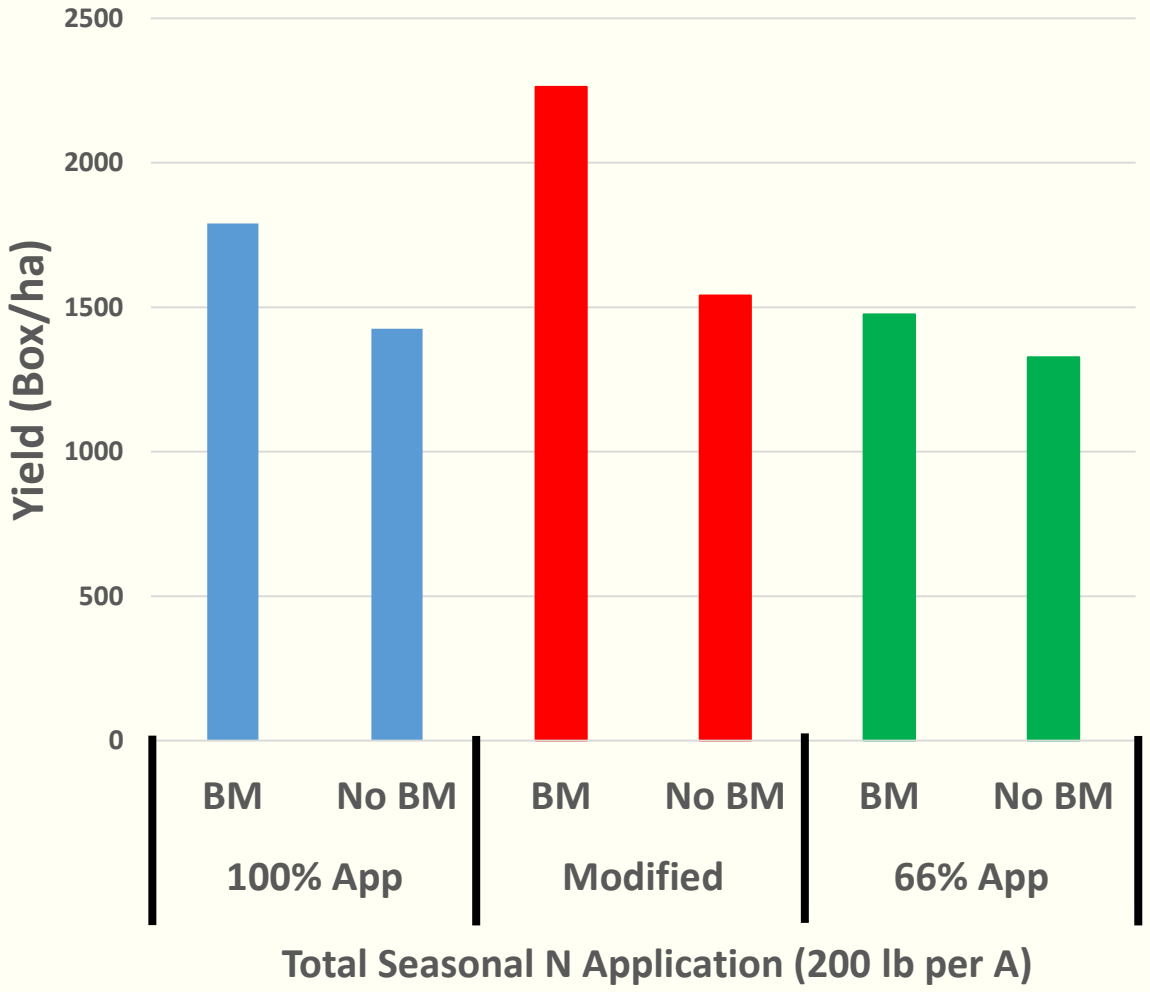


Low water rate (66% App)



Tomato root production increased under 66% App (lower irrigation) compared to 100% App early in the

Results: Yield (Box/Acre)



- Modified irrigation (66% App early and 100% App from 6 WAT) and N timing improve crop performance and increase tomato yield
- Increase in yield can result in higher economic return per unit area

Study #4: Alternative bedding system (H2Grow System)

Alternative bedding system: Potential advantage & challenges

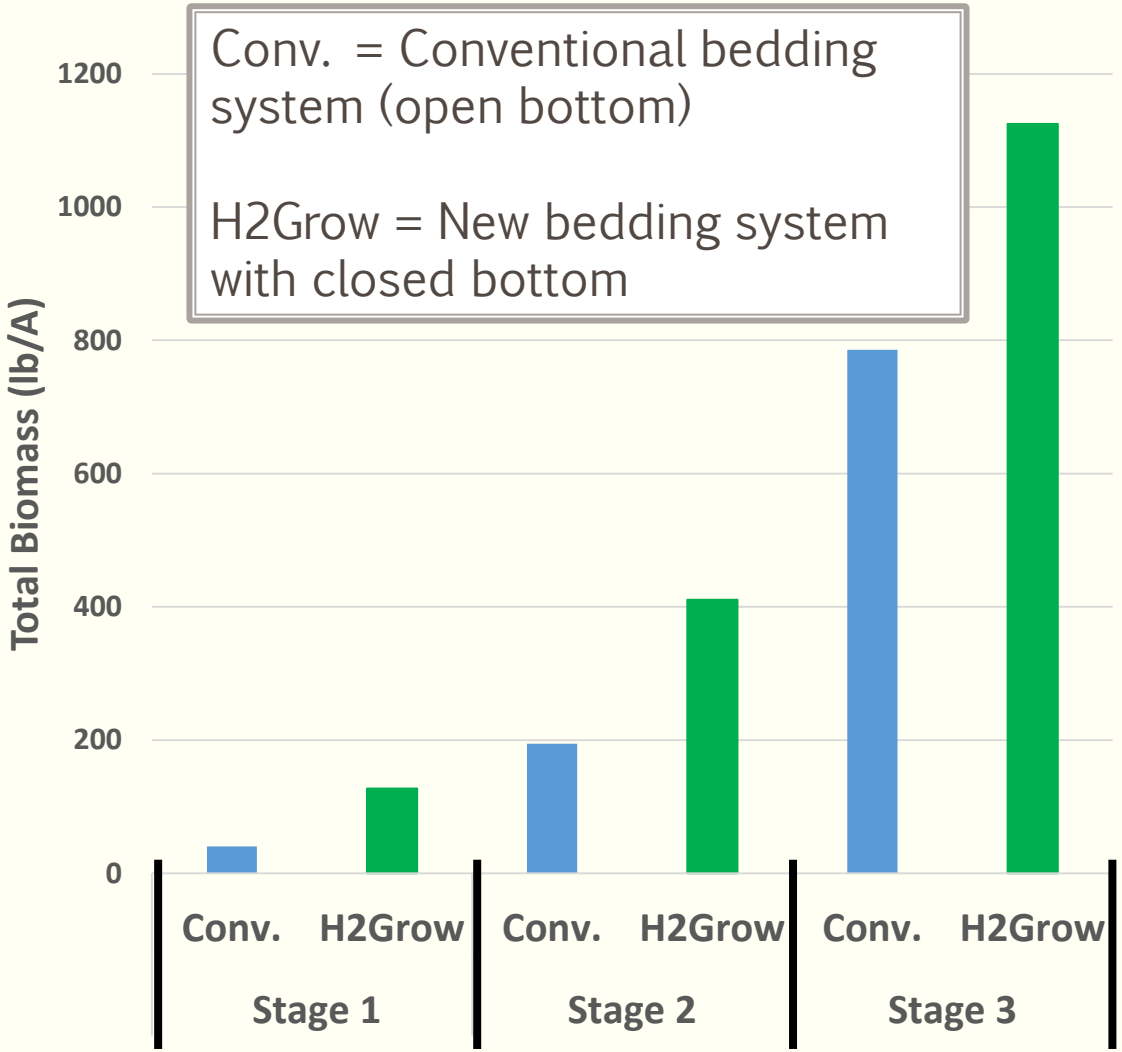
Potential advantages

- Can eliminate nutrient leaching
- Reduce irrigation-water pumping cost
- Can eliminate nematode infection
- Can reduce production cost*

Potential challenges

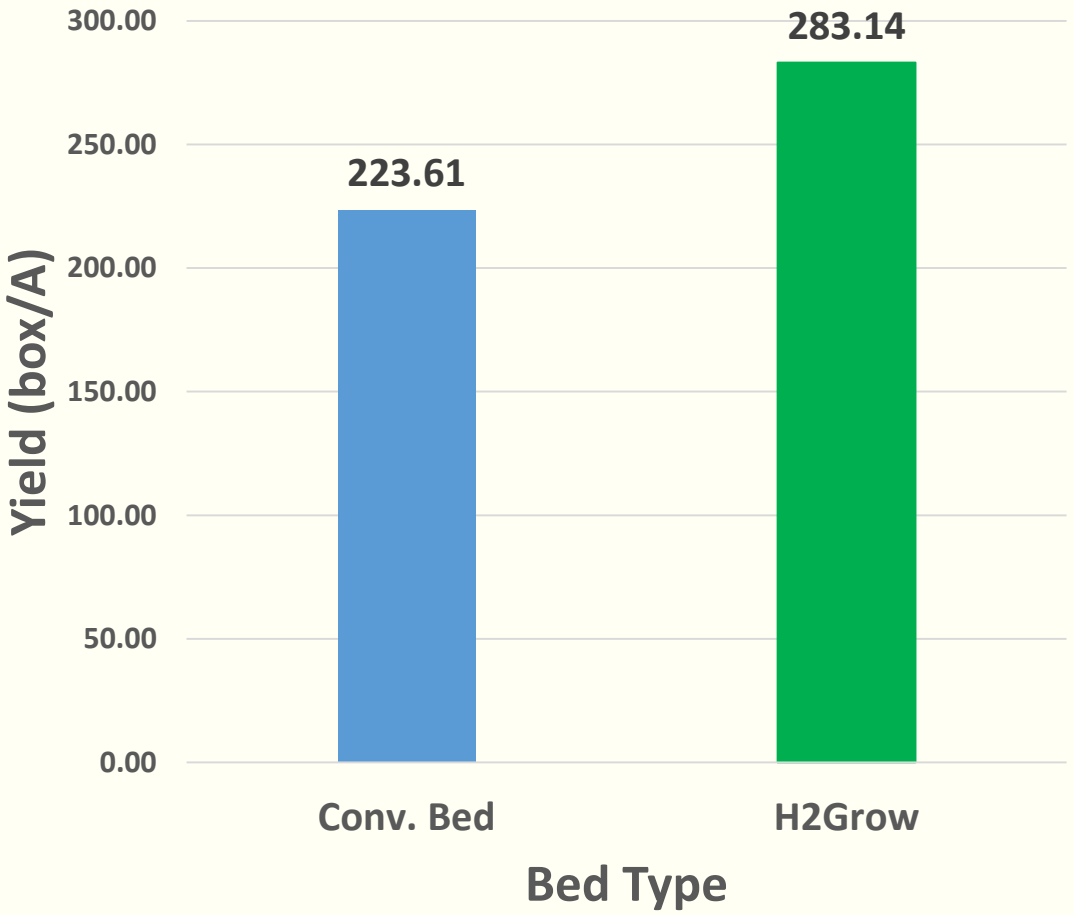
- May increase initial cost
- Appropriate fumigant
- Overall management – Under investigation

Result: Tomato growth curve



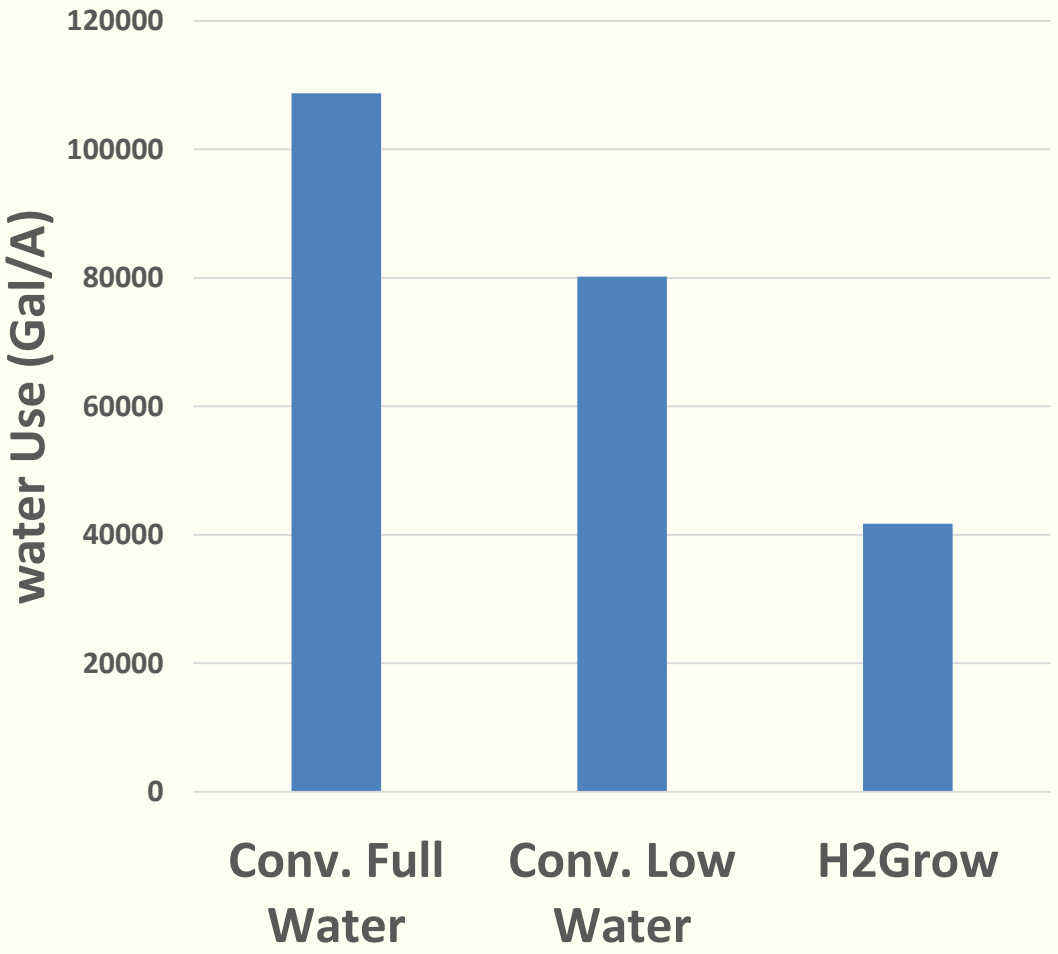
- H2Grow system consistently increase tomato growth compared to the conv. system
- Increase in biomass production can reduce sun damage and increase marketable yield
- Greater biomass may increase CO_2 use efficiency hence yield increase

Result: Yield (First harvest, X-large only)



- Preliminary data shows that H2grow bed can potentially increase tomato yield up to 20% compared to the conv. bed
- Up to 60 boxes increase for extra-large fruit category at first harvest
- Increase in crop yield can potentially increase crop economic return

Result: Water Use (First 10 weeks after transplant)



- H2Grow bed reduce water up to 62% compared to conventional bedding system
- This implies a saving of up to 62% reduction in irrigation cost (Fuel price)
- H2Grow system can potentially eliminate negative environmental consequences of tomato production (nutrient leaching) especially on sandy soils.

Conclusions

- Irrigation water use was lower for SI App compare to the recommended growers standard
- SI App increase tomato yield
- N application rate above 160 lb/A–N may not increase tomato yield
- Modified irrigation and N application timing increase tomato yield
- H2Grow system can significantly reduce production cost, nutrient-based pollution and maintained tomato yield
- Efficient irrigation and N management can reduce contamination and production cost with no reduction in yield and fruit quality

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THANK YOU

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