Organic Baby Spinach Production Using Drip Irrigation

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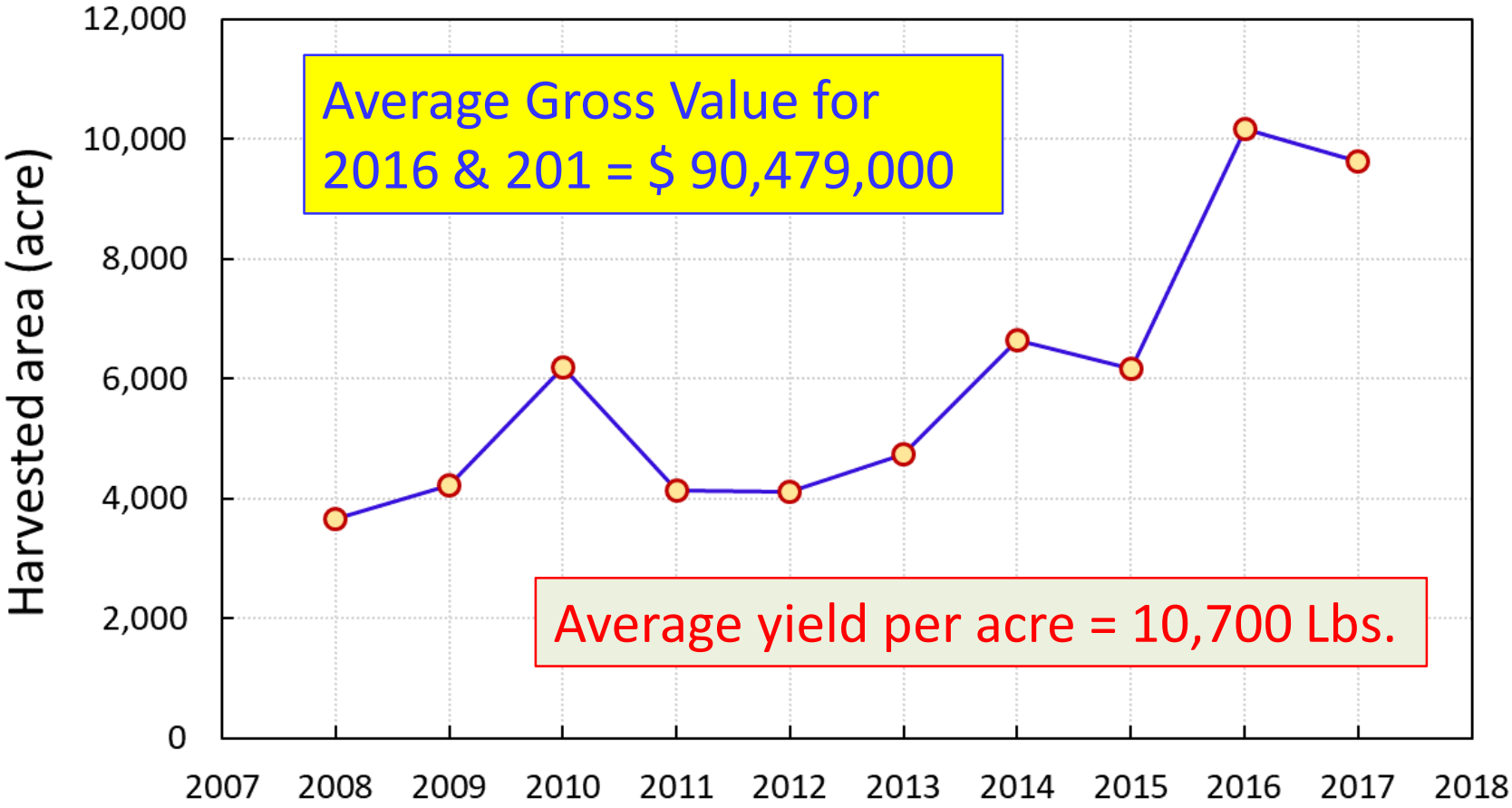
Trends of spinach production acreage in the Imperial Valley (2008-2017)



Spinach Production (Imperial Valley)

Solid-set Sprinkler
(80” bed)

Linear Move Overhead
(no bed)

Why DRIP for organic spinach?

- Downy mildew on spinach as a widespread and very destructive disease.
- The most important disease in spinach production (crop losses can be significant the Imperial and Salinas Valleys).
- In the low desert, spinach downy mildew typically occurs between mid-December and the end of February.
- Although fungicides are available for the control of this disease in conventional production, products with similar efficacy are not available for organic production. Therefore, additional strategies are needed to reduce disease pressure.

- The obligate oomycete pathogen *Peronospora effuse* requires cool & wet conditions for infection and disease development.
- The dense canopy of spinach retains much moisture and creates ideal conditions for infection and disease development.
- Spores (called sporangia) are dispersed in the air from plant to plant and field to field by winds and splashing water.
- Overhead irrigation could contribute to the speed and severity of downy mildew epidemics within a field when other conditions such as temperature are favorable.

Experiments

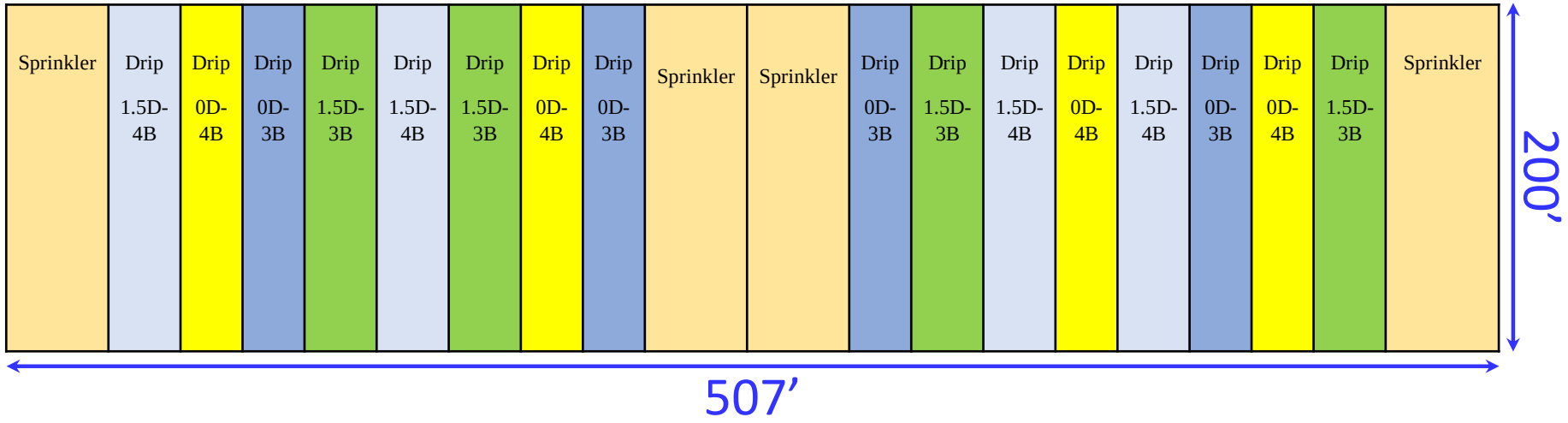
- The field experiments were conducted at the UC Desert Research and Extension Center.
- Untreated Viroflay spinach seeds were planted (a rate of 42 lbs. per acre) on October 31st.
- Five irrigation system treatments consist of:
  - two drip depths (driplines on the soil surface and driplines at the 1.5-inch depth)
  - two dripline spacings (three driplines on an 80-inch bed and four driplines on an 80-inch bed)
  - sprinkler irrigation (80-inch bed)
- The experiment was arranged in a randomized complete block with four replications.

Special thanks to Vessey Farm for supporting this study with planting spinach seeds and sharing thoughts.

All treatments were germinated by sprinklers (first crop season- Fall 2018).

Silty CLAY Loam Soil

Plot plan



Drone Image

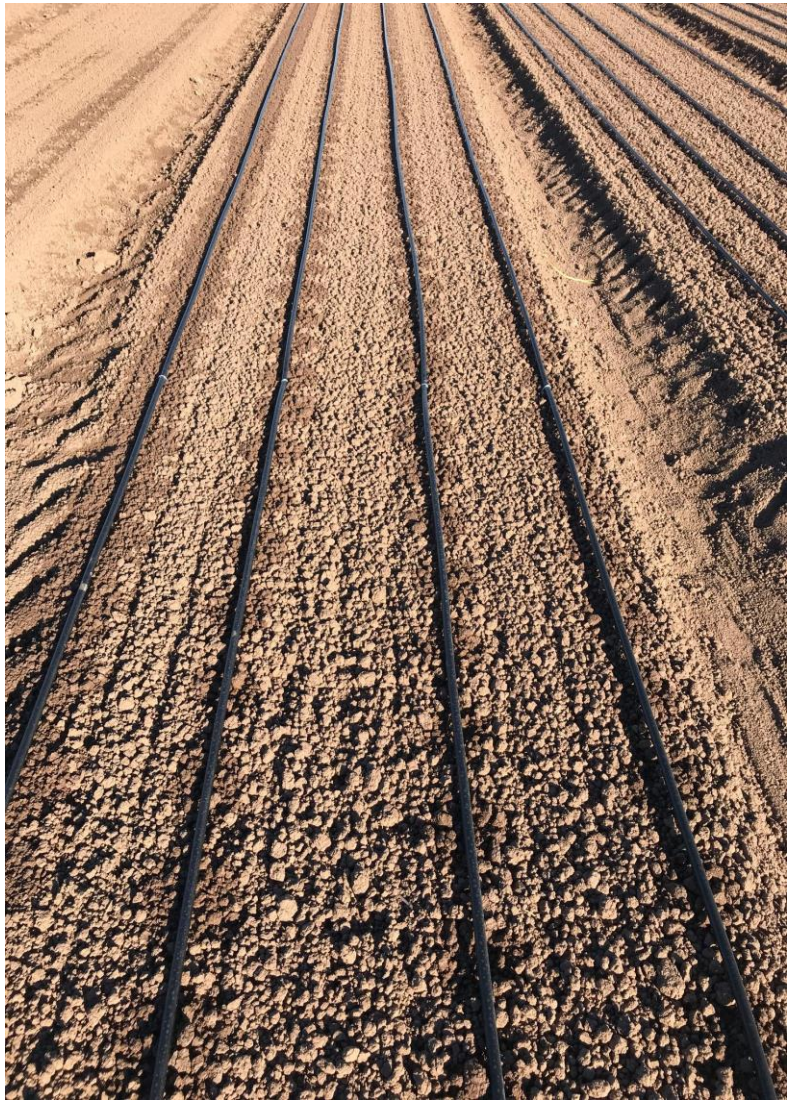
Drip Tape (Flow Control Drip Tape of Toro)

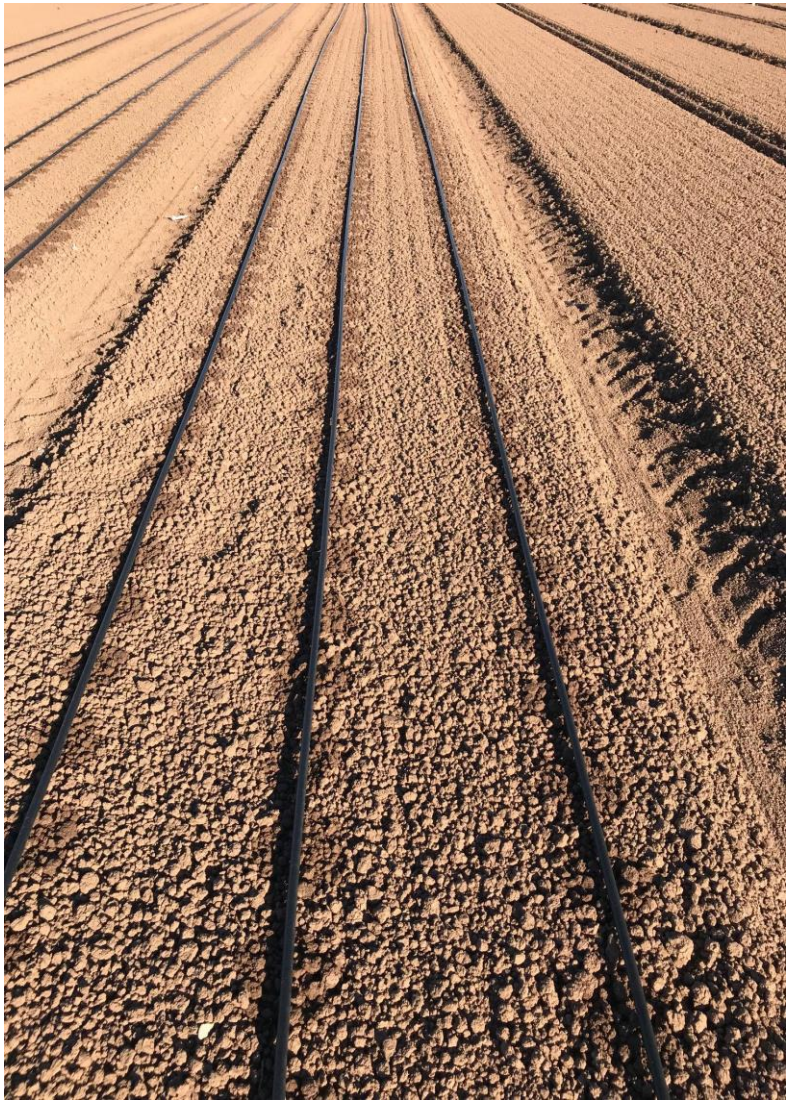
- Hose diameter: 5/8” (16 mm)
- Wall thickness: 6 mil (0.15 mm)
- Emitter spacing: 8” (20 cm)
- Emitter flowrate: 0.13 gph @ 8 psi

  (0.34 gpm/ 100 ft.)

  (487’ run with 94% CU)

Water distribution along/between laterals





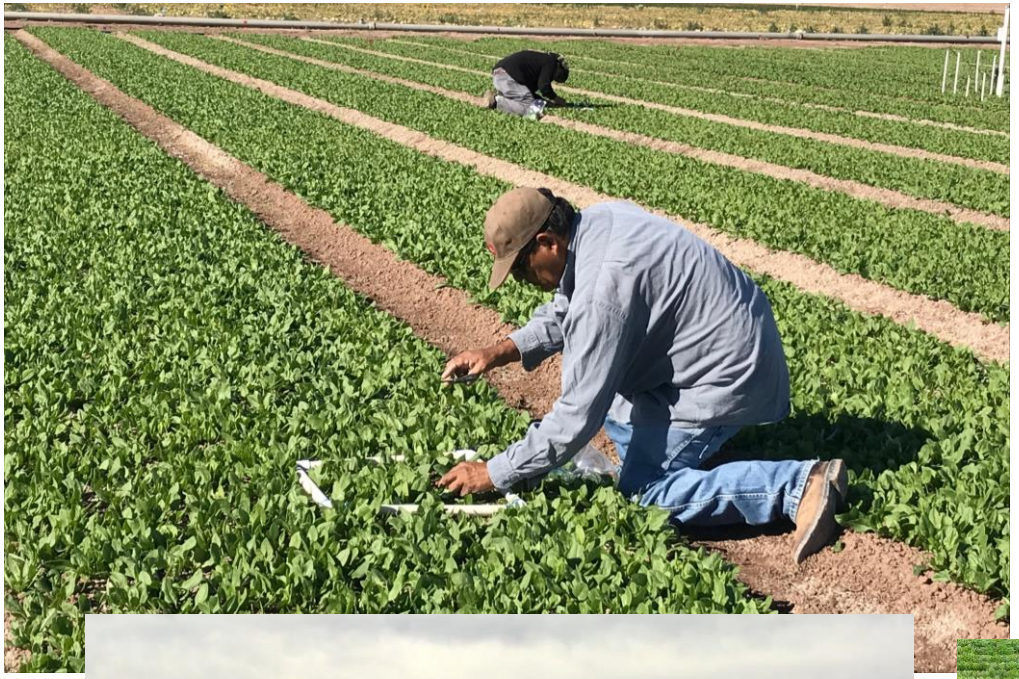
Water distribution along/between laterals

Fertilizer application

- True 6-6-2 (a homogeneous pelleted fertilizer from True Organic Products) at a rate of 80 lbs. of N per acre as pre-plant fertilizer,
- True 4-1-3 (a liquid fertilizer from True Organic Products) as complementary fertilizer through injection into irrigation system:
  - ✓ For the drip system, it was applied three times after germination at a rate of 40, 30, and 40 lbs. of N per acre.
  - ✓ For the sprinkler system, it was applied at a rate of 45, 35, and 45 lbs. of N per acre.

18 days after planting

38 days after planting

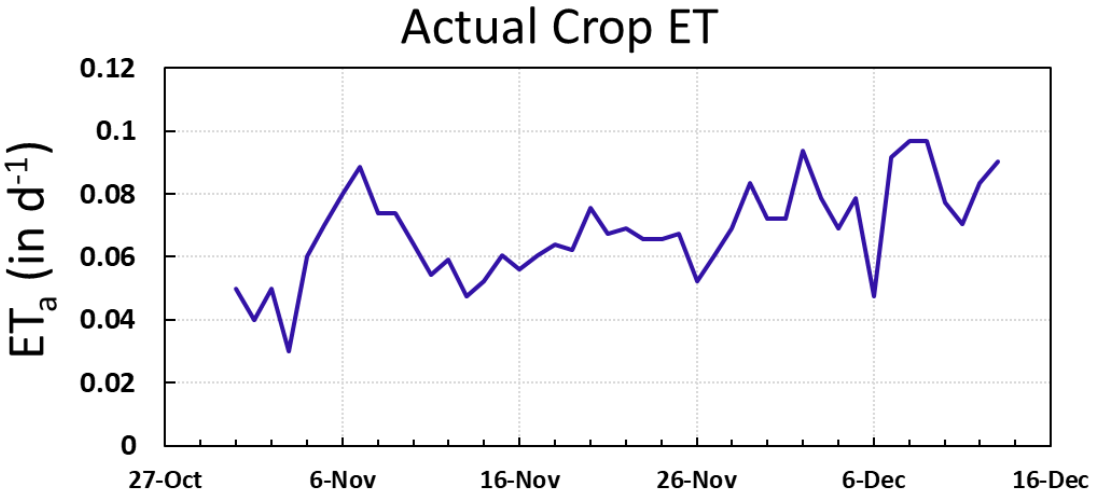


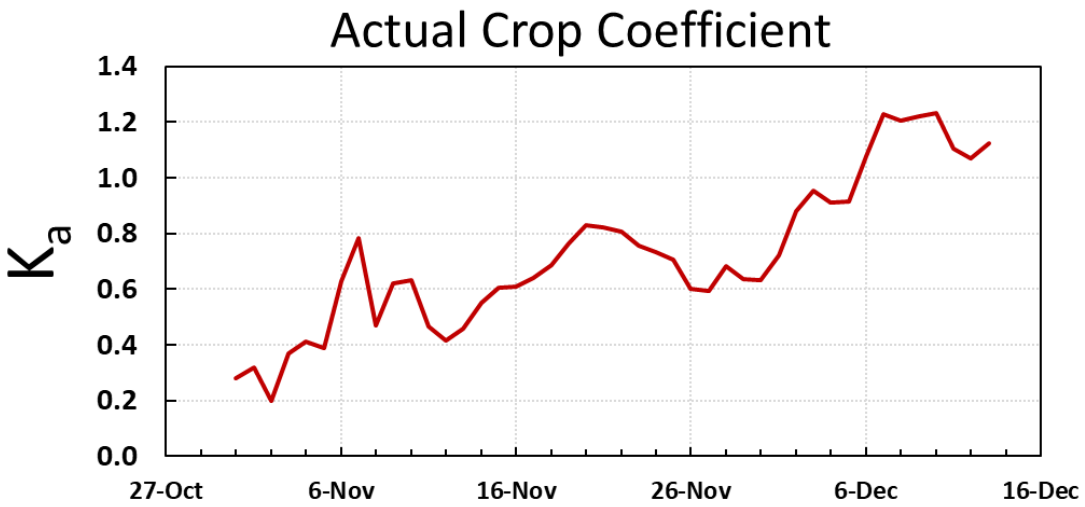
Weekly plant samples for plant tissue nitrogen analysis

Yield Sampling (late season)

Soil Sampling (early/late season)

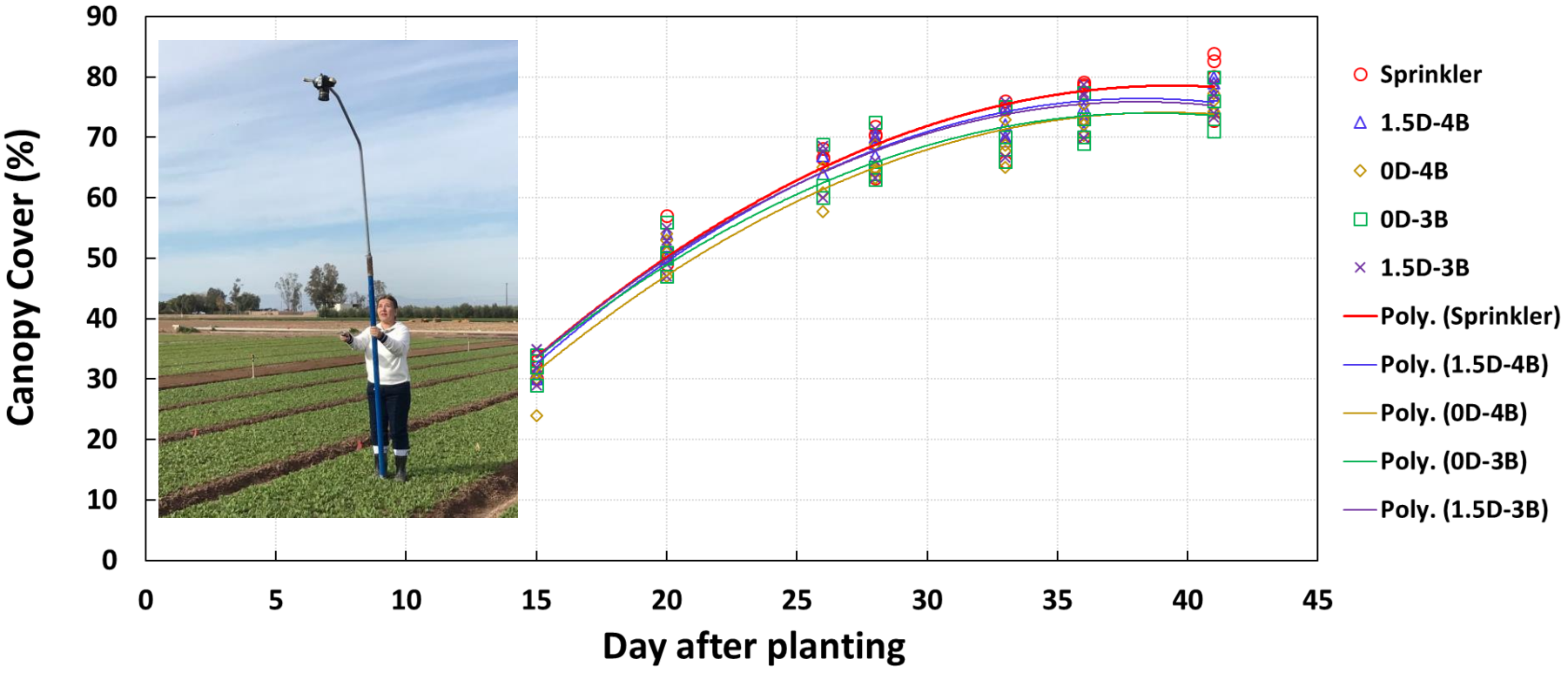
Actual Crop Water Use (Tule Technologies)





$$ET_a = K_a \times ET_o$$

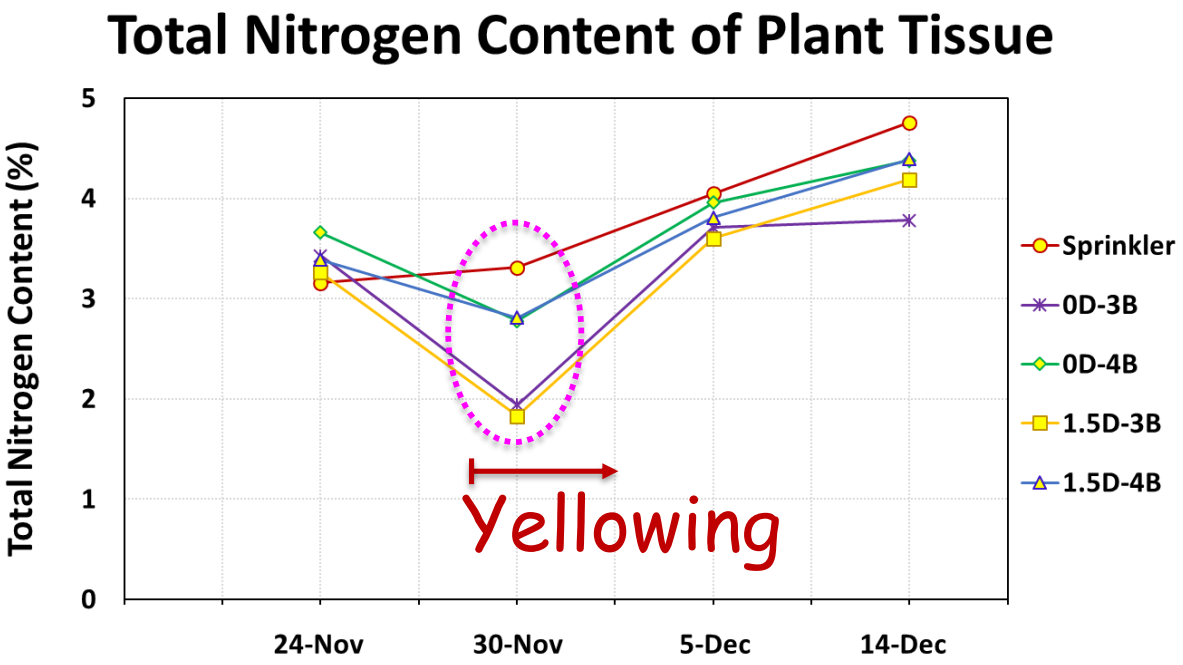
Crop Canopy Development over the crop season



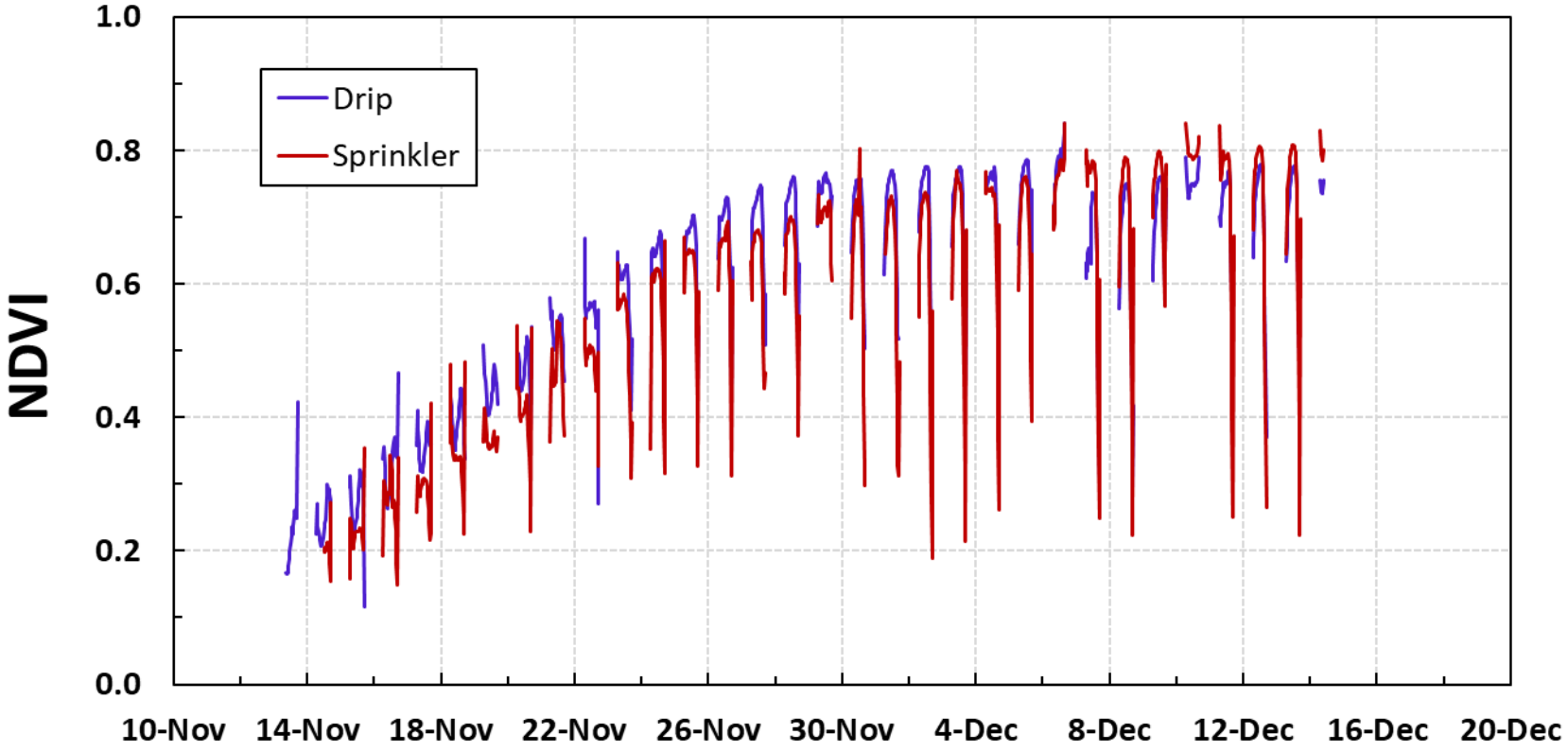
Infrared Pictures

Yellowing issue in drip trials

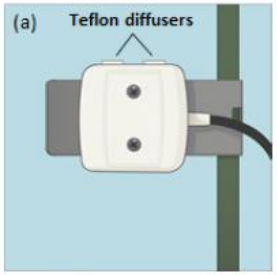
Bed with 3- dripline

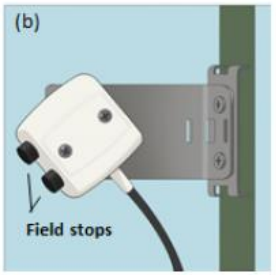


30-minute Daily NDVI (Drip vs. Sprinkler)

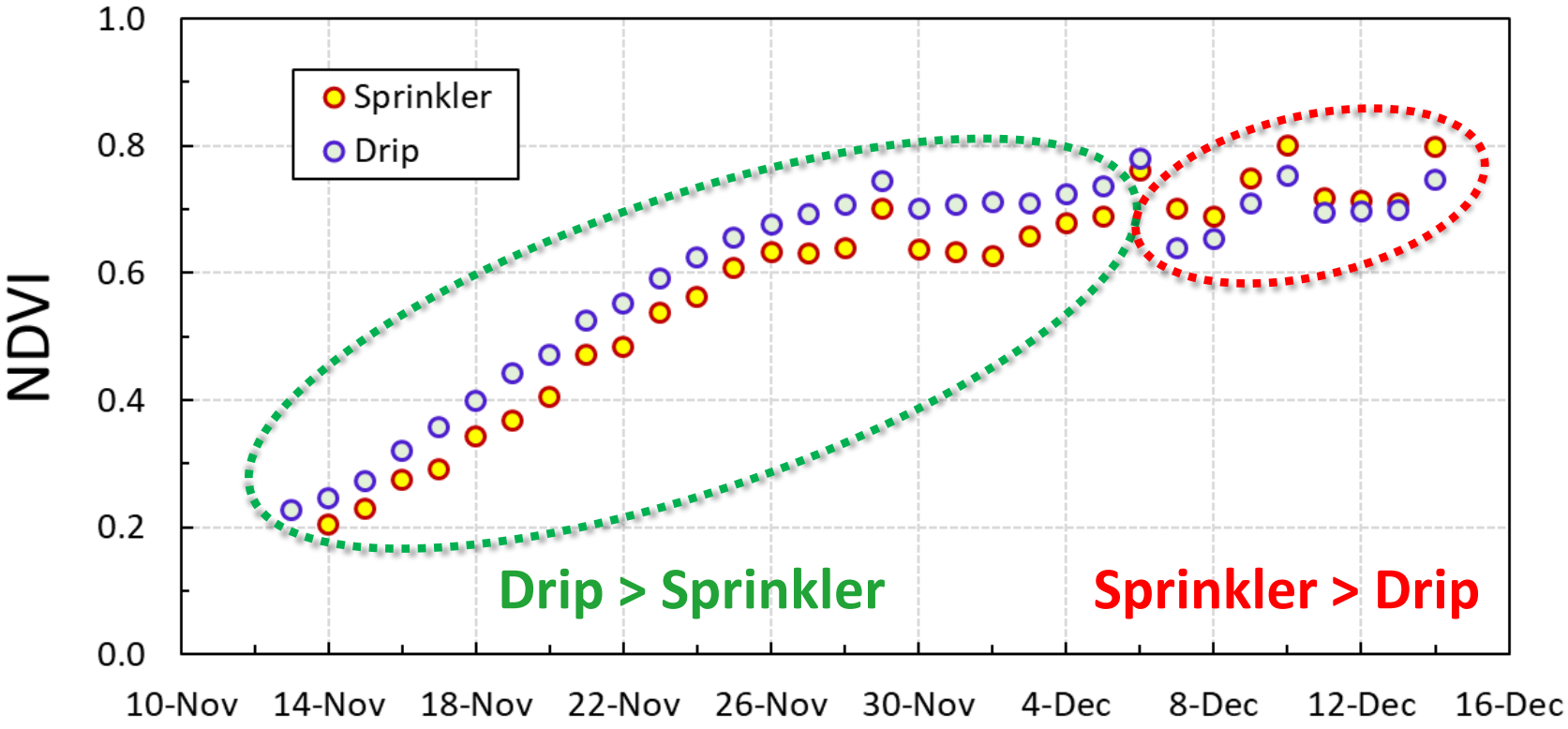


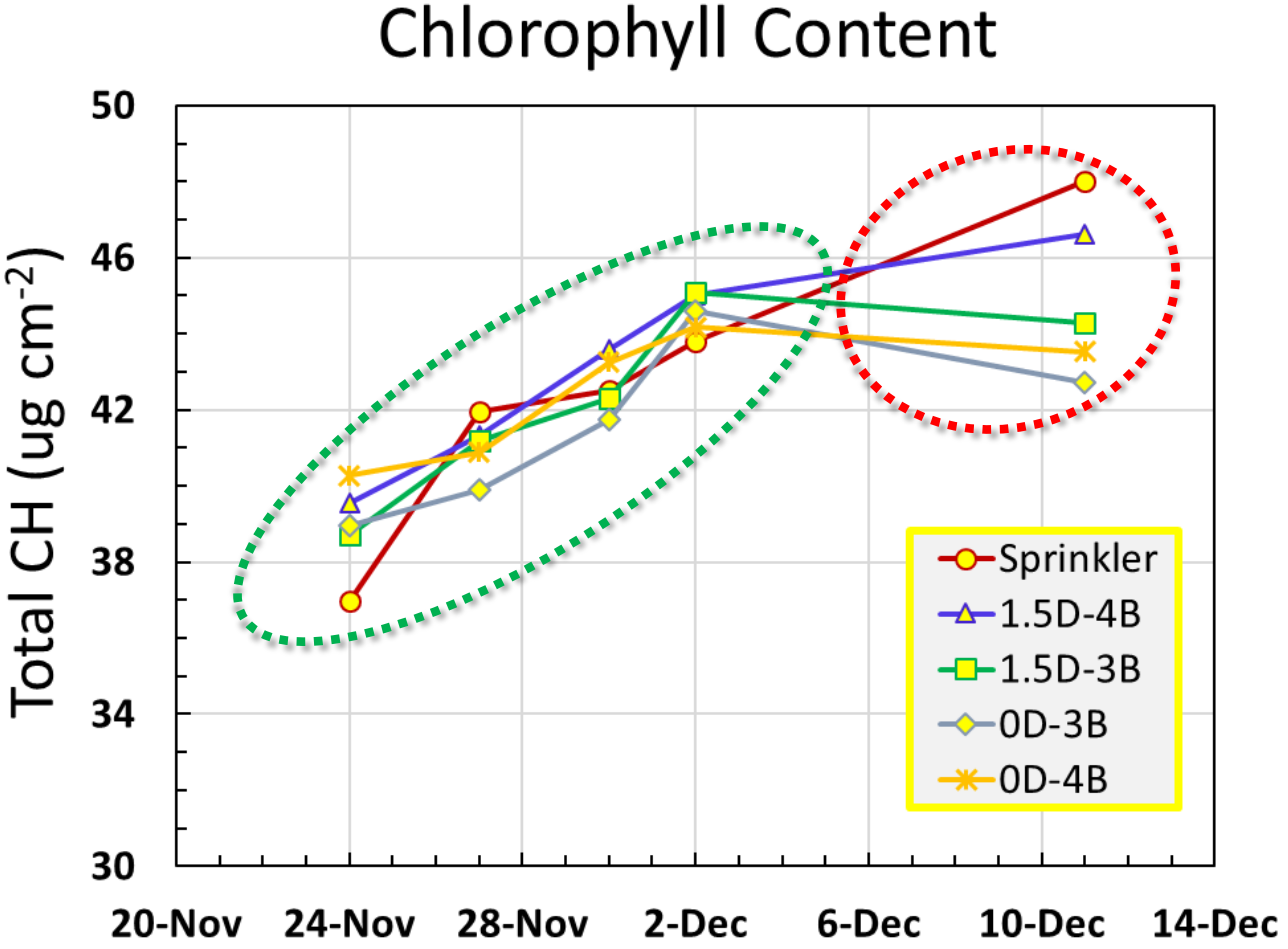
Spectral Reflectance Sensors





Average Daily NDVI (Drip vs. Sprinkler)



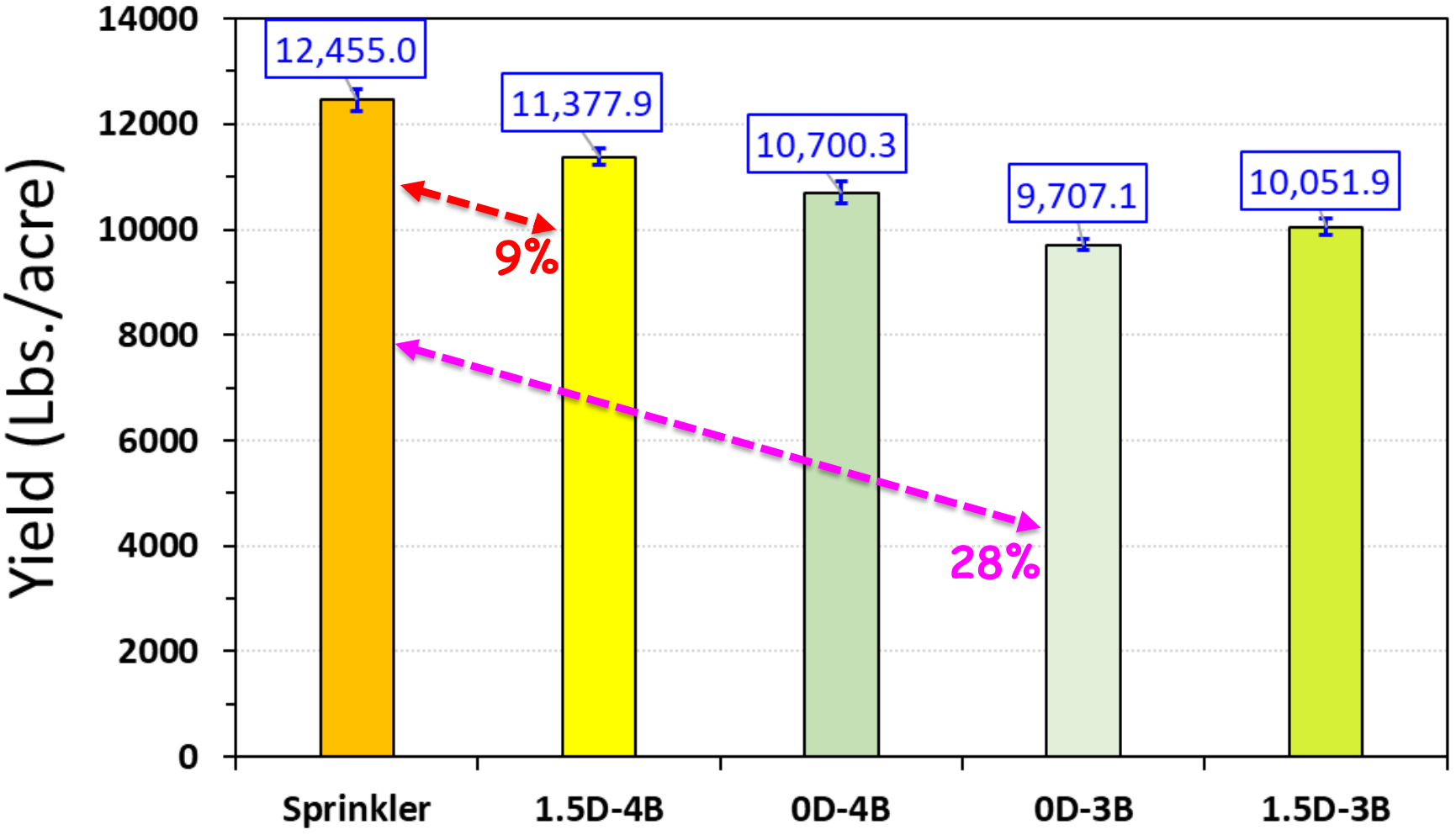


atLEAF
Chlorophyll Meter

Surface drip is not practical.

- **T**he driplines moved around due to wind until the crop canopy is fully developed.
- **S**urface drip might be problematic for growers since the drip line would need to be removed before harvest and would pose a food safety risk.

Fresh Yield Comparison



Downy mildew was not observed during a disease scouting on Dec. 4 and at any point during the crop.

Future Experiments

- The project is planned to be conducted over three-year in the Imperial Valley (Year 1 and 2) & the Salinas Valley (Year 3).
- During the second year of project, we will eliminate the surface drip irrigation treatments for its inefficiency but will add nitrogen levels to the drip-treatment trials.
- We will evaluate drip irrigation for the whole crop season (germination and remainder of crop season).

Germination spinach seeds (drip vs. sprinkler)

(second crop season- Winter 2019)

Sprinkler

Drip

Germination spinach seeds (drip vs. sprinkler)

(second crop season- Winter 2019)

Treatment	GR (%)
Sprinkler	96
Sprinkler + 4-dripline	97
Sprinkler + 3-dripline	95
4-dripline	93

Preliminarily Conclusions

- **D**rip irrigation demonstrated the potential to produce organic spinach, conserve water, and enhance the efficiency of water and nitrogen use.

- **F**urther work is needed to evaluate the viability of utilizing drip (optimal system design, the impacts of I & N management practices, and strategies to maintain spinach productivity and economic viability) at spinach.

Fund and contribution

California Leafy Greens Research Board

Thank You (Q & A)

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