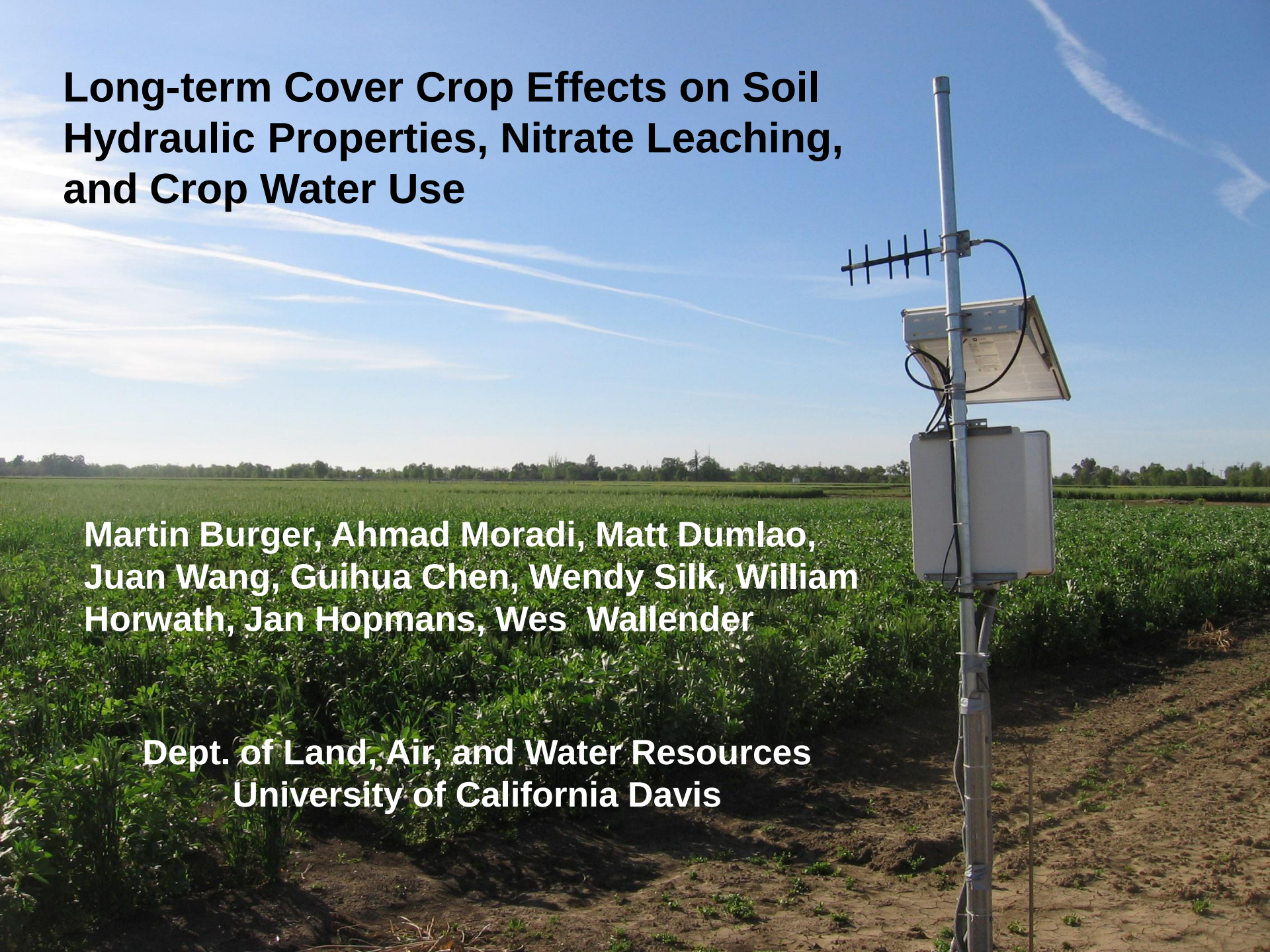
Long-term Cover Crop Effects on Soil Hydraulic Properties, Nitrate Leaching, and Crop Water Use



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Since 1994:
Tomato-corn rotations:
- **Winter-cover cropped**
- **Winter-fallow**

Furrow-irrigation
Since 2010 also subsurface drip irrigation

Silt loam and clay loam soils

Cover Crop Management

How do changes in soil properties due to long-term cover cropping affect

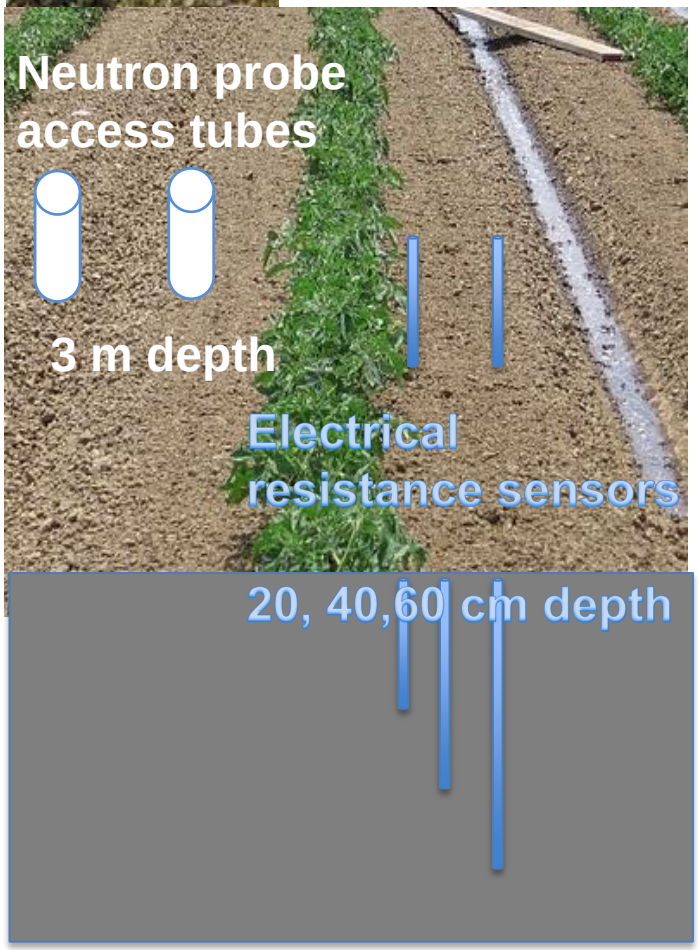
- **Irrigation:**
  - **Infiltration**
  - **Applied irrigation water use efficiency**

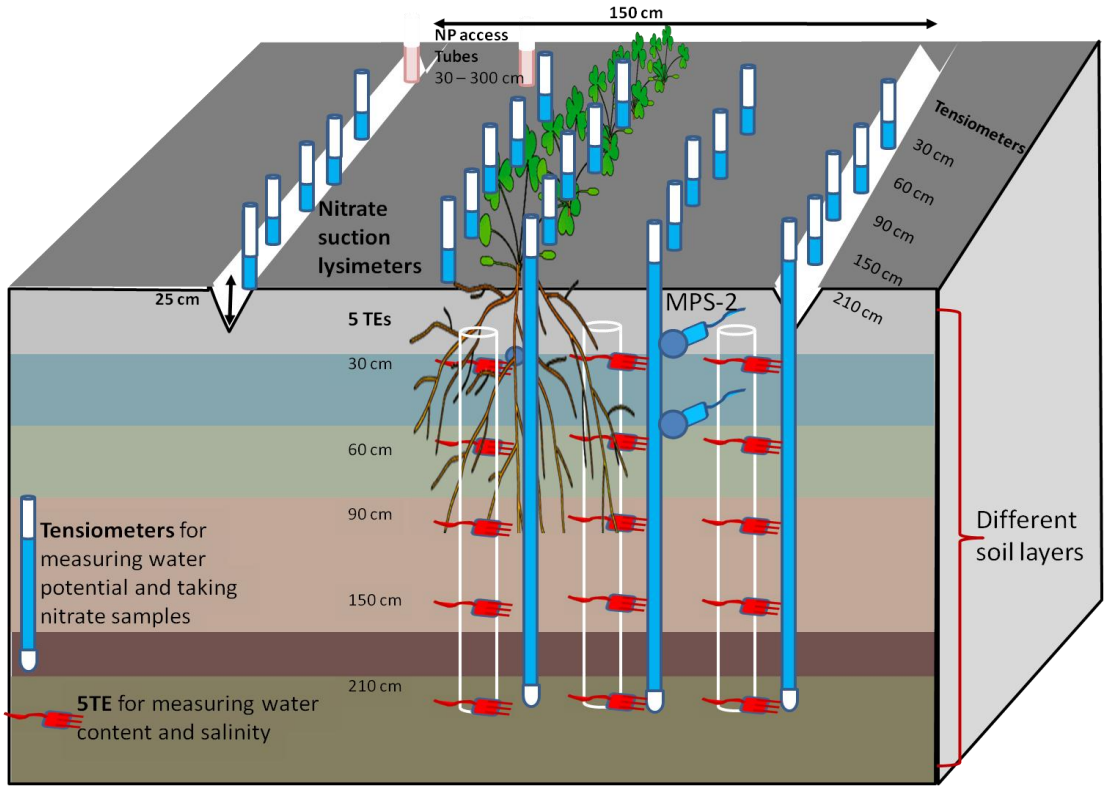
- **Water movement in the soil:**
  - **Lateral and vertical movement of water**
  - **Drainage below the root zone**
  - **Nitrate leaching?**

Furrow-irrigated tomato

Subsurface drip irrigation

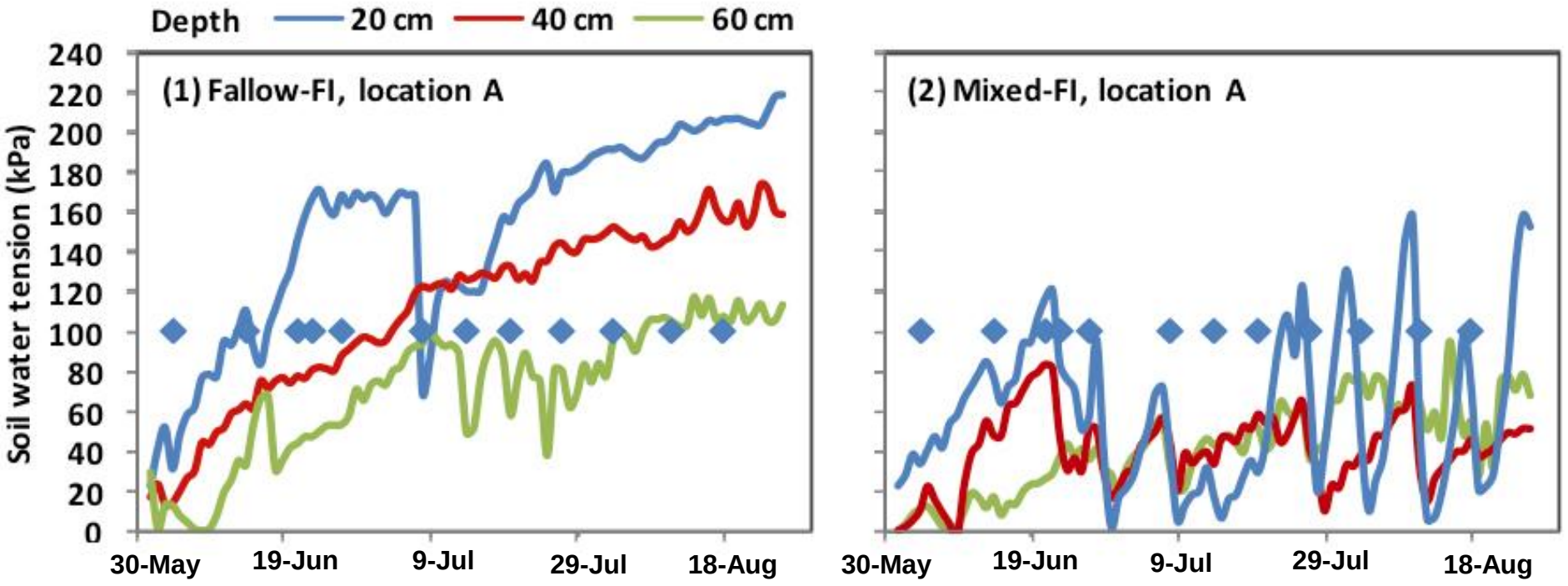
Instruments to measure soil water content, soil water potential, nitrate in the soil solution





Tensiometers & soil moisture sensors
30, 60, 90, 150, 210 cm depth

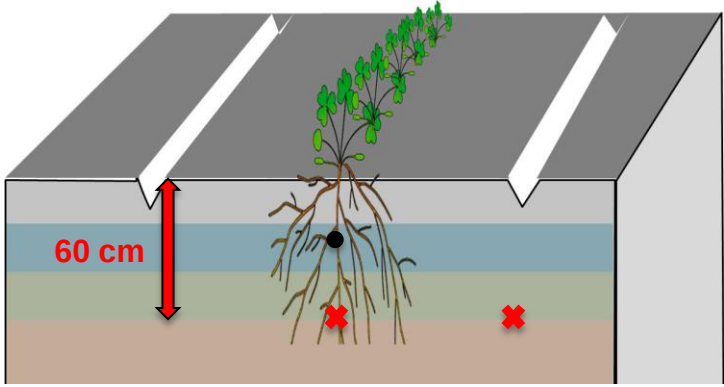
Results
Infiltration with Furrow Irrigation (Tomato Crop)

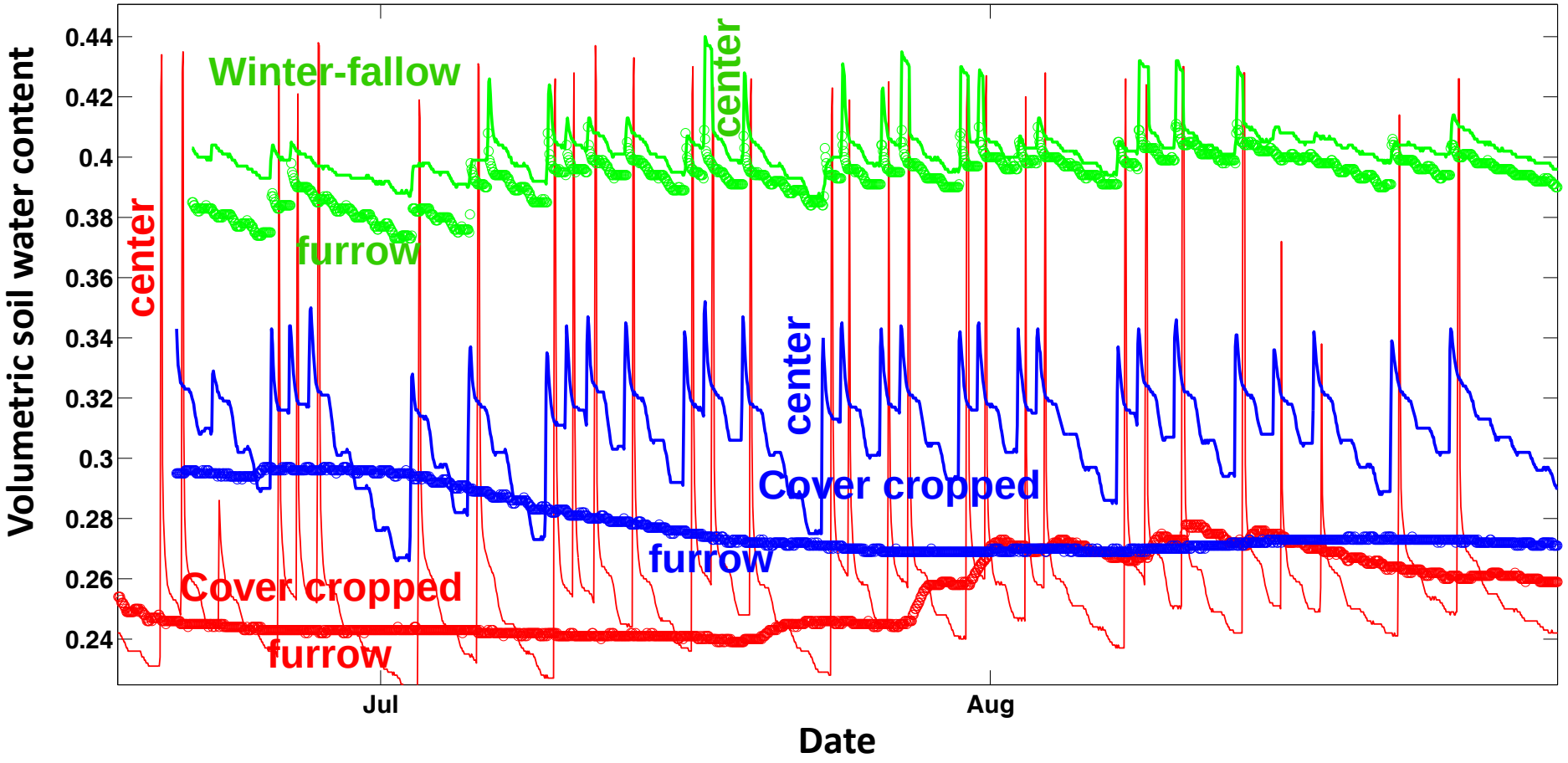


Infiltration impeded in winter-fallow treatment

Subsurface drip-irrigation

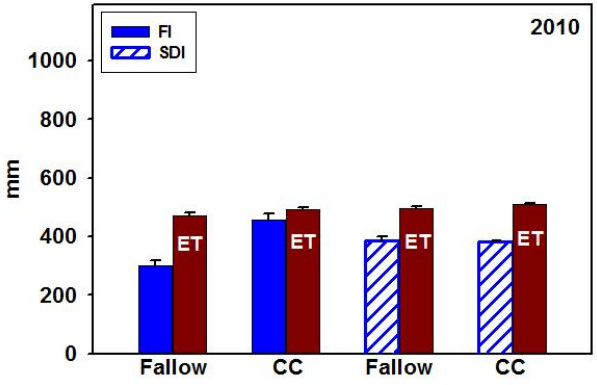
Soil moisture at 60 cm depth below drip tape and furrow positions in three fields with different management and soil texture

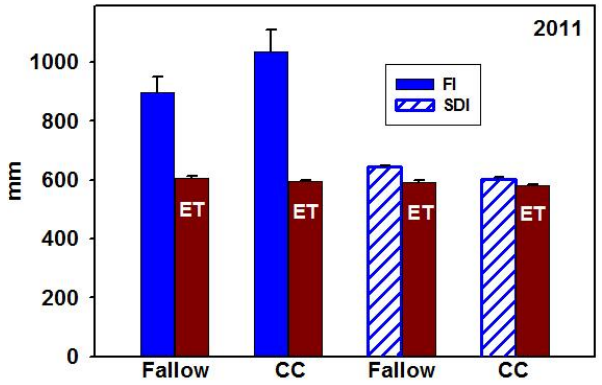


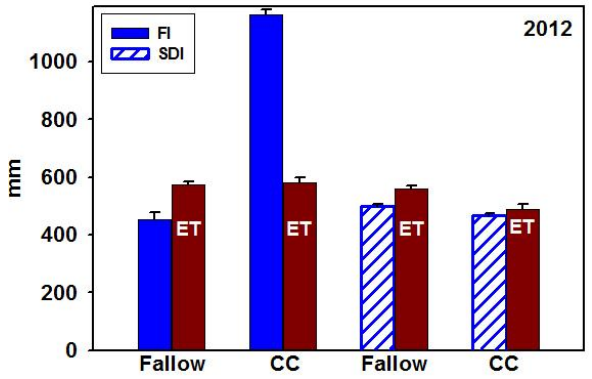


Results
Water Balance Tomato Growing Seasons

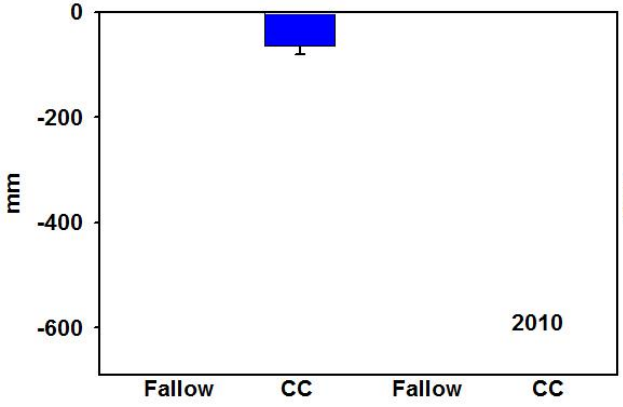
Applied water & ET

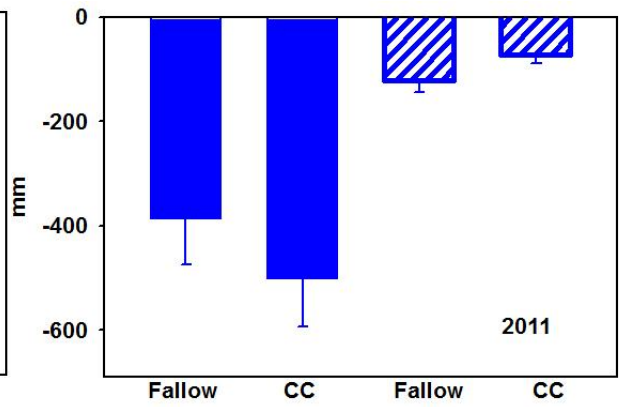


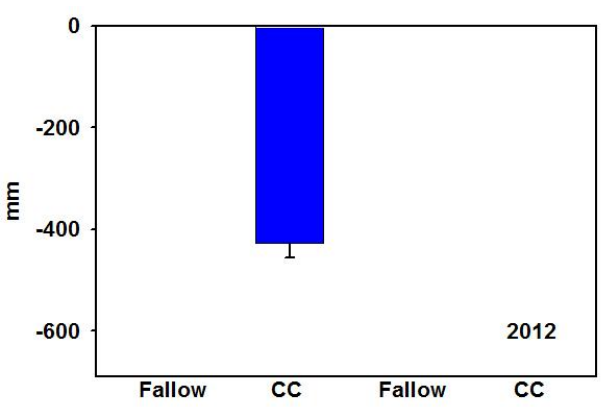




Drainage below the root zone

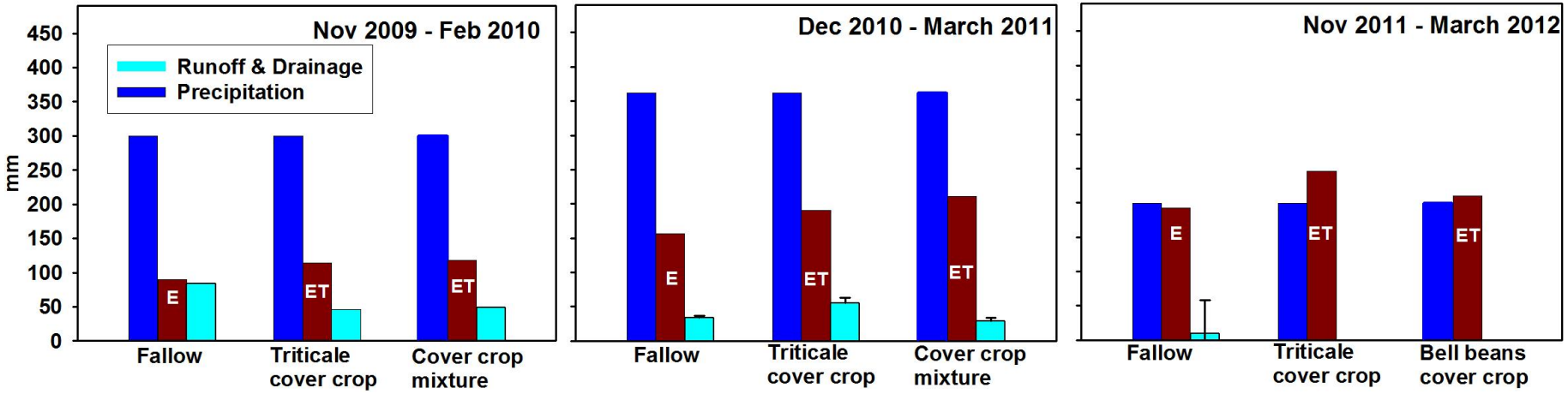






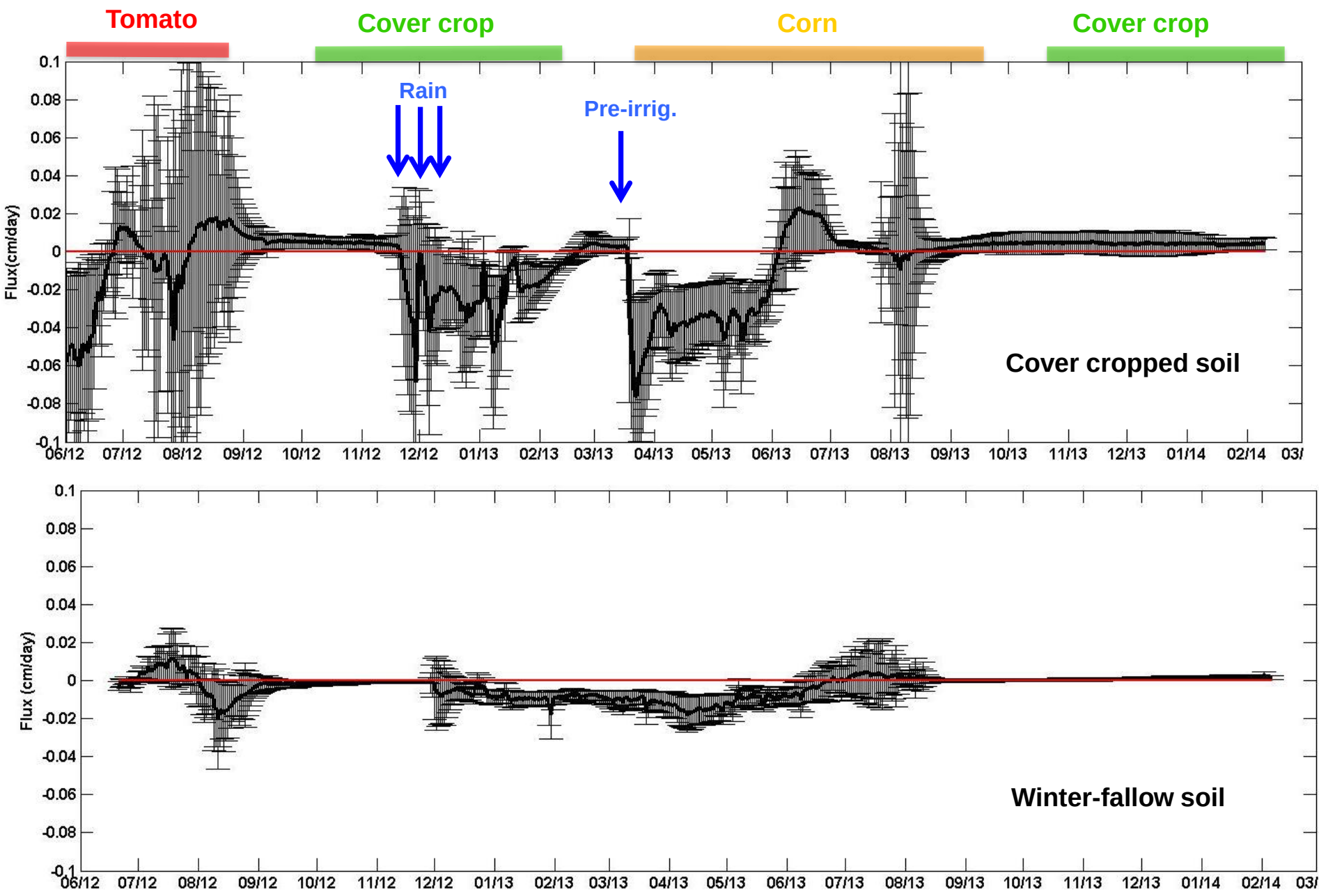
Results:
Rainy Season Water Balance

Precipitation, evapotranspiration, drainage & runoff



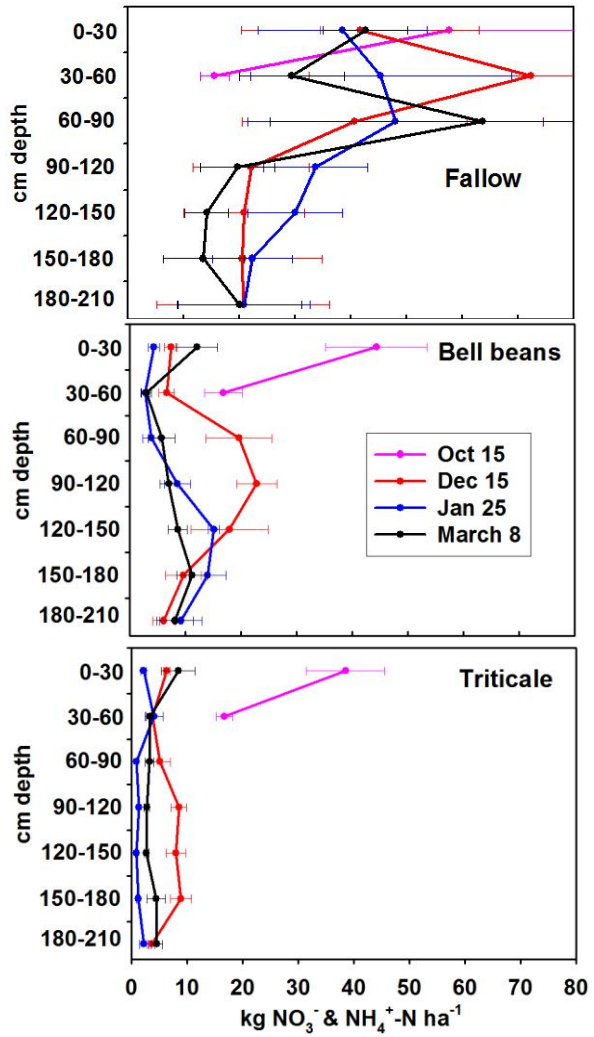
Relatively less drainage in rainy seasons 2010 – 2012 than during the irrigation seasons

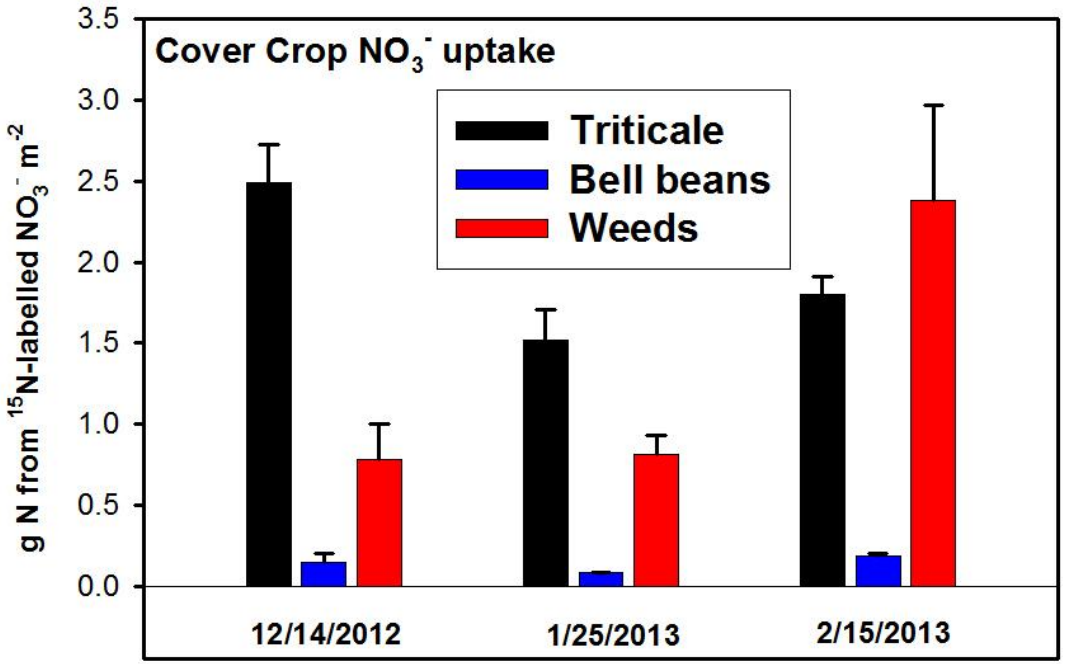
Water Flux between 90-150 cm (June 2012 – present)



Results
$^{15}NO_3^-$ uptake by cover crops

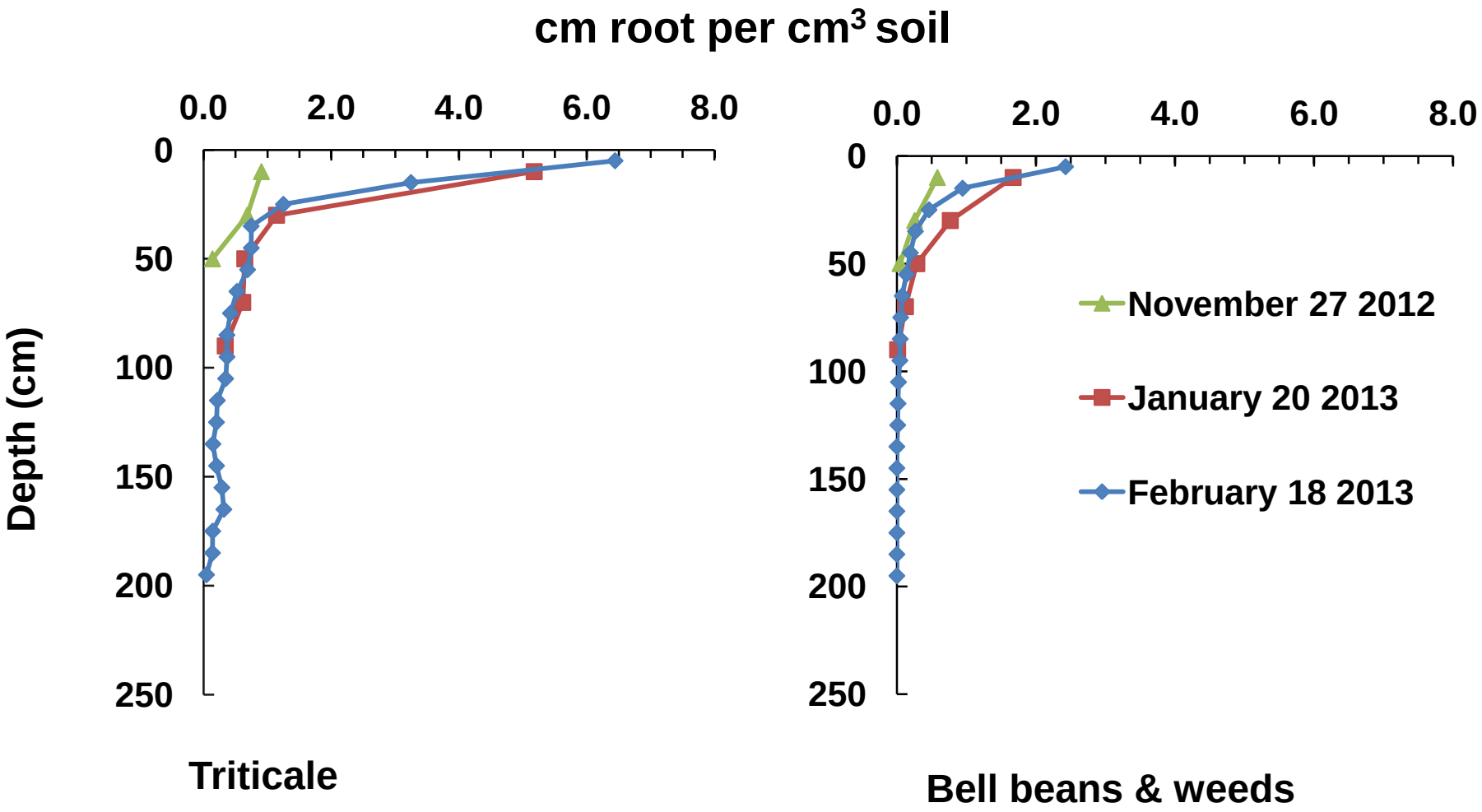
Inorganic N in soil profile





Triticale cover crop immobilized 15 times more NO_3^- than bell beans.

Root Length Density Distribution of Cover Crops




Fri 14 September 2012
Bell bean
Mon 29 October 2012
BELL BEAN 19/05/2012
BELL BEAN 10/05/2012
After 19 days

Conclusions

- **Long-term cover crop use enhanced infiltration properties.**

- **Less lateral and greater vertical flow in cover cropped than in winter-fallow soil.**

  Hypothesis: Long-term cover cropping facilitates water flow through channels made by roots.

- **Downward water flux most likely early in the irrigation season and after the growing season with rainfall in fall/early winter.**

- **To minimize NO_3^- leaching, optimizing fertigation N additions and irrigation frequency at the beginning of the growing season are important - especially in cover cropped soil.**

- **Cover crops can immobilize NO_3^- in the surface layers if they are established before heavy rainfall periods.**

THANKS!

Acknowledgments

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