What soil instrumentation can tell us about water and nitrate movement in the root-zone of crops?

CDFA Project:
Evaluation of cover crop in reducing nitrate leaching in tomato fields

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With the help of soil sensors and monitoring techniques, we aim at quantifying:
- Water and nitrate uptake by crop roots
- Water and nitrate leaching below the root zone
- The spread of irrigation water in the soil profile in relation to roots
- etc.

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Instrumentation layout
- Multiple sensors at various depths and locations for each treatment plot
- Sensors are connected to loggers and data collected remotely
- Hourly and daily measurements of water and nitrate redistribution following irrigation, fertigation and uptake by roots

Treatments:
Winter fallow
Triticale
Bell beans
Instruments list and functions:

1. Tensiometers:
   - measures soil matric potential, range: -850 - 0 mbar
   - individually-calibrated pressure transducers
   - Also used for calculating flux across a known soil layer by logging the water potential gradients
2. Decagon STE sensors:
   - measures soil water content, electrical conductivity, temperature
3. Decagon MPS-2 sensors:
   - measures soil matric potentials, range -4000 mbar – 0
4. Neutron Probe
   - measures soil water content, large representative soil volume
5. Suction lysimeters (empty tensiometers):
   - is used to collect soil solution for nitrate analysis
6. Equilibrium-Tension Lysimeters:
   - measures drainage below the root zone and collect soil solution samples for nitrate analysis

An example of soil moisture monitoring:

- Moving water extraction depth in the soil profile as roots grow deeper
- Soil matric potential shows how hard it is for roots to extract water from soil
  - the drier the soil the more negative matric potential