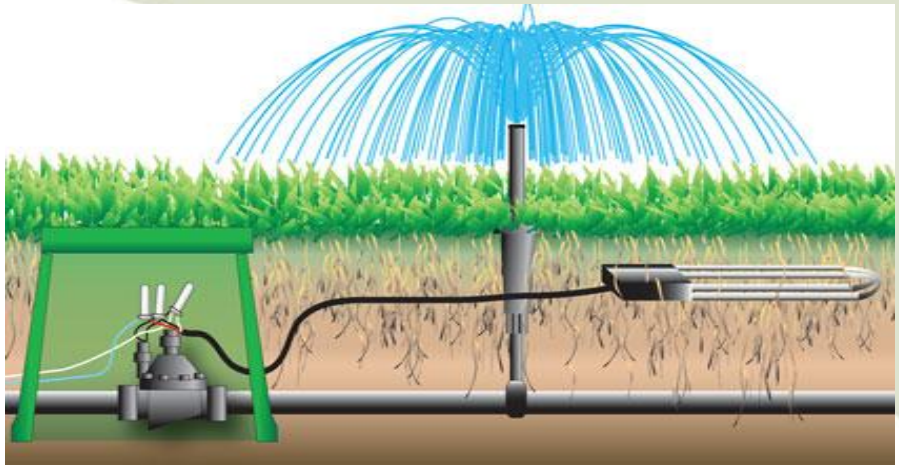

# Irrigation controller mechanically actuated by soil-water tension


**PhD. Student: Alexsandro Almeida**

**Advisor in Brazil: Tarlei Botrel**

**Advisor in Australia: Steven Raine**

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# IRRIGATION AUTOMATION

NCEA

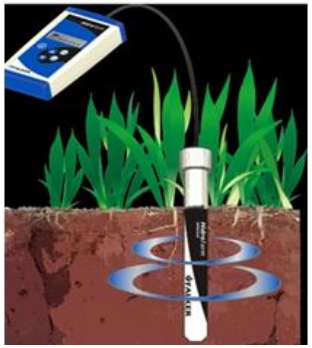
- Improve the efficiency in water and fertilize use
- Reduce labour cost
- Saving in energy, water and cost
- Minimize environmental impact
- Operational flexibility

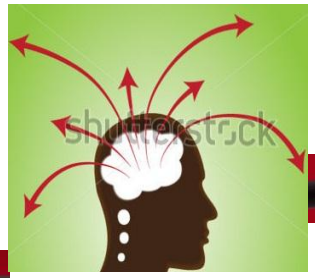
# Overview of an irrigation control systems (soil-based)

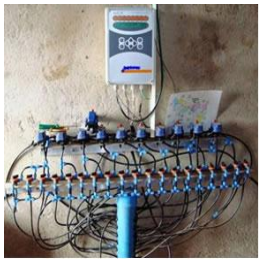
**Sensor**

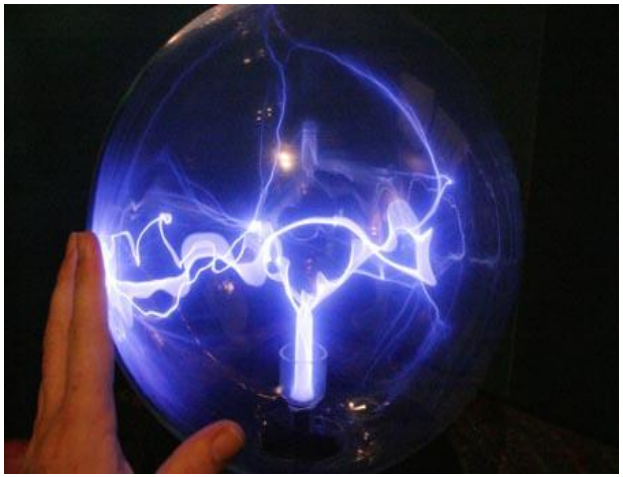
**Controller**

**Actuator**









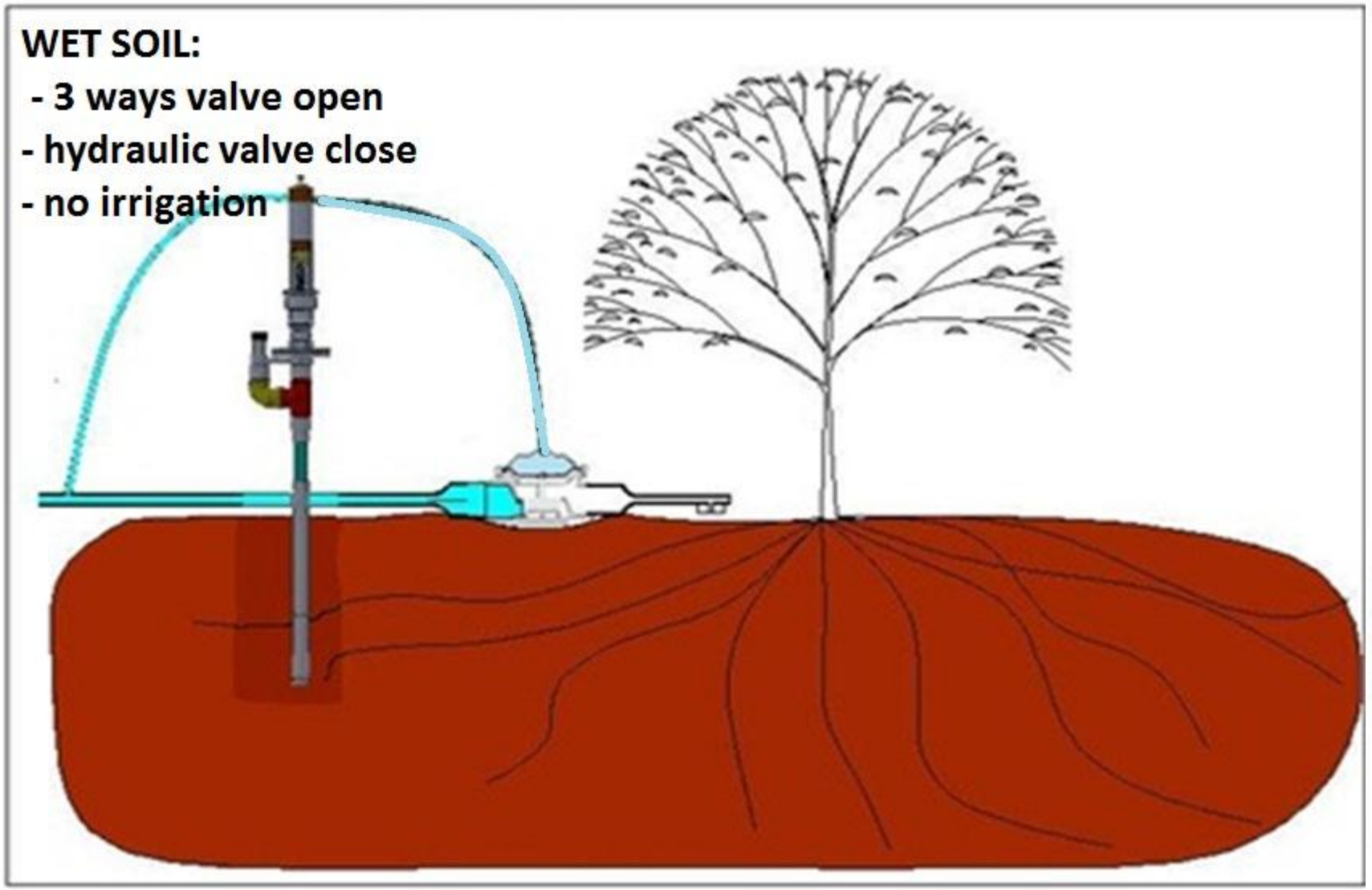
**Electrical power requirement**

**Roughly 350–400 million households, or 40% of the population of developing countries, have no access to electricity**

**(Humanitarian Technology Challenge, 2006)**


# Irrigation systems pressurized by gravity


# Operational principle

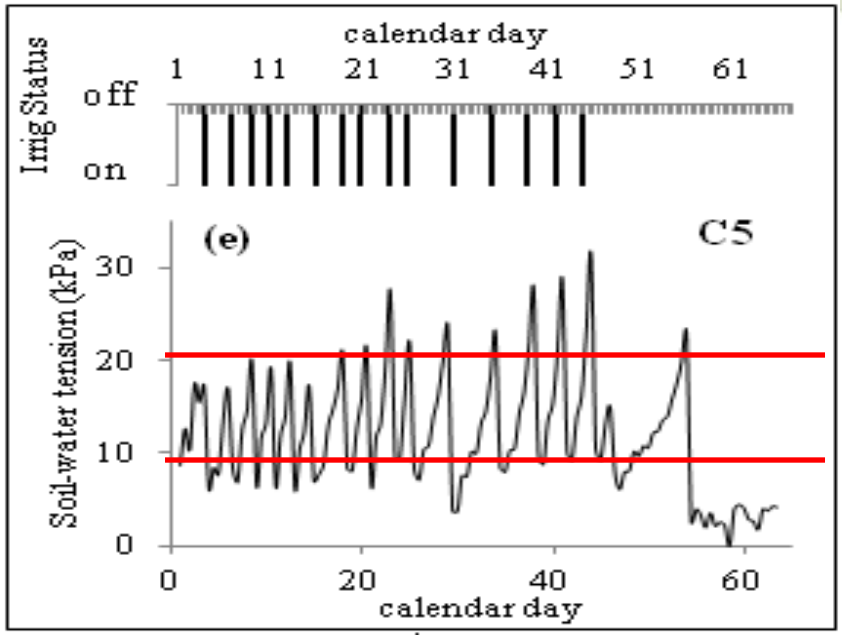


# Prototype

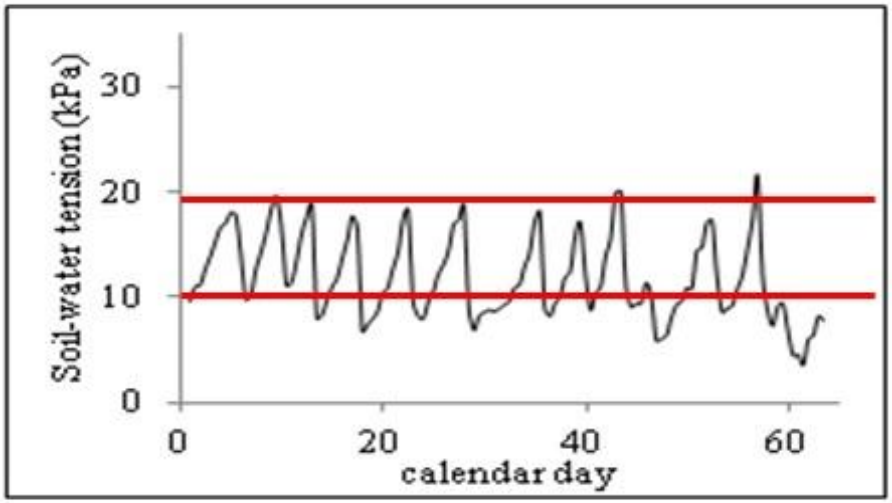
# Prototype

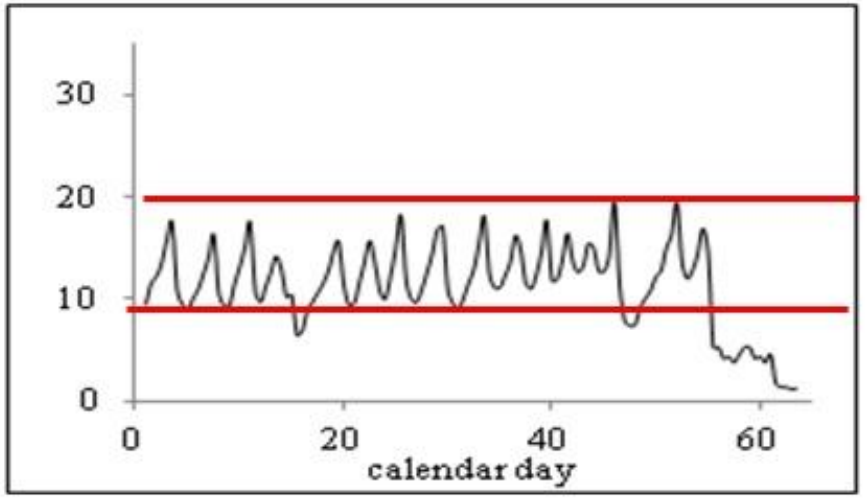
# Evaluation in a fruit orchard

# Irrigation controller performance




**Prototype activated (initiate and terminate irrigation) autonomously the irrigation over the entire period of evaluation (without maintenance requirements).**



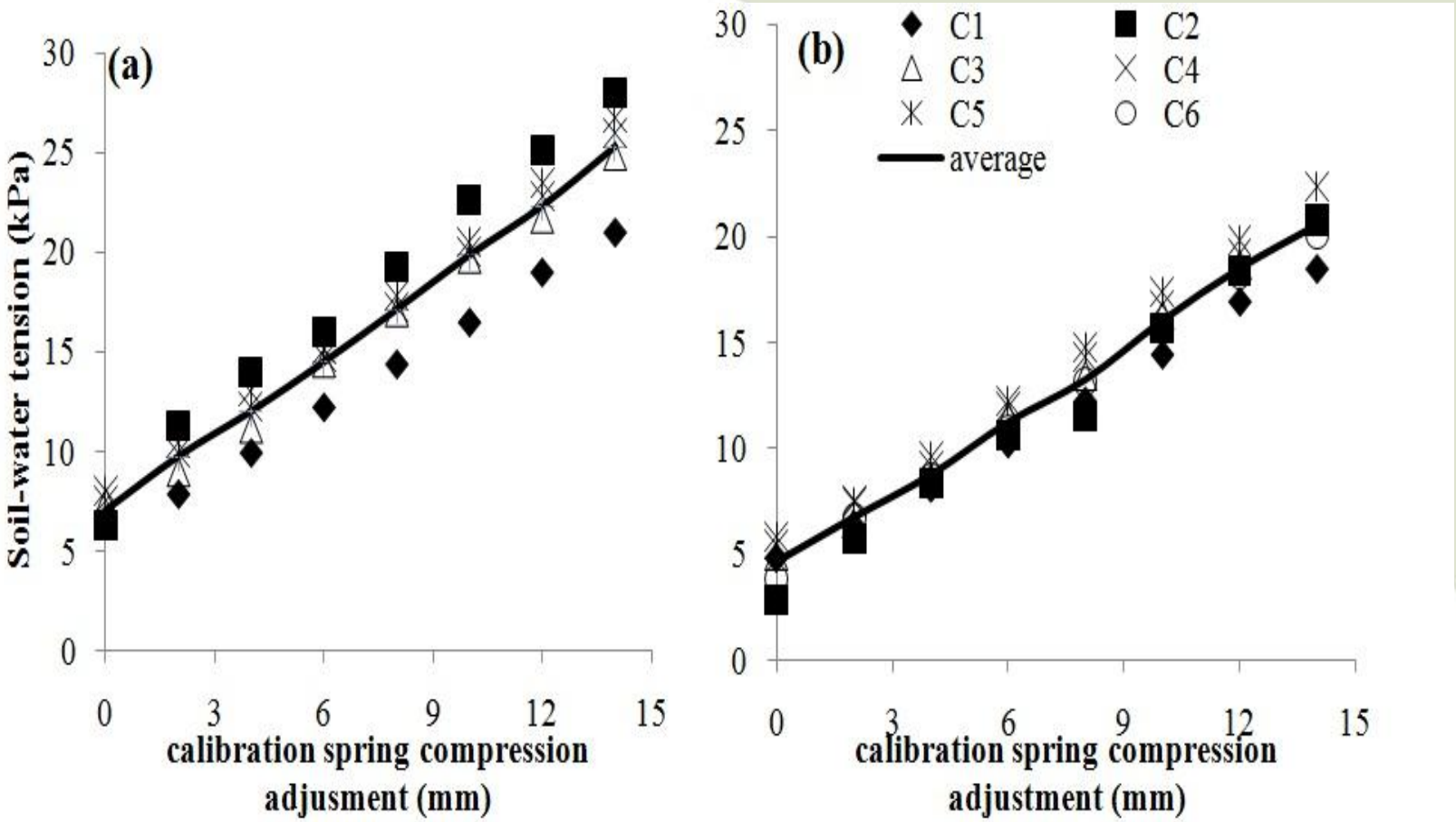



**Fig.** (a) Soil water tension (kPa) required to initiate irrigation and (b) Soil water tension (kPa) required to cut off irrigation.

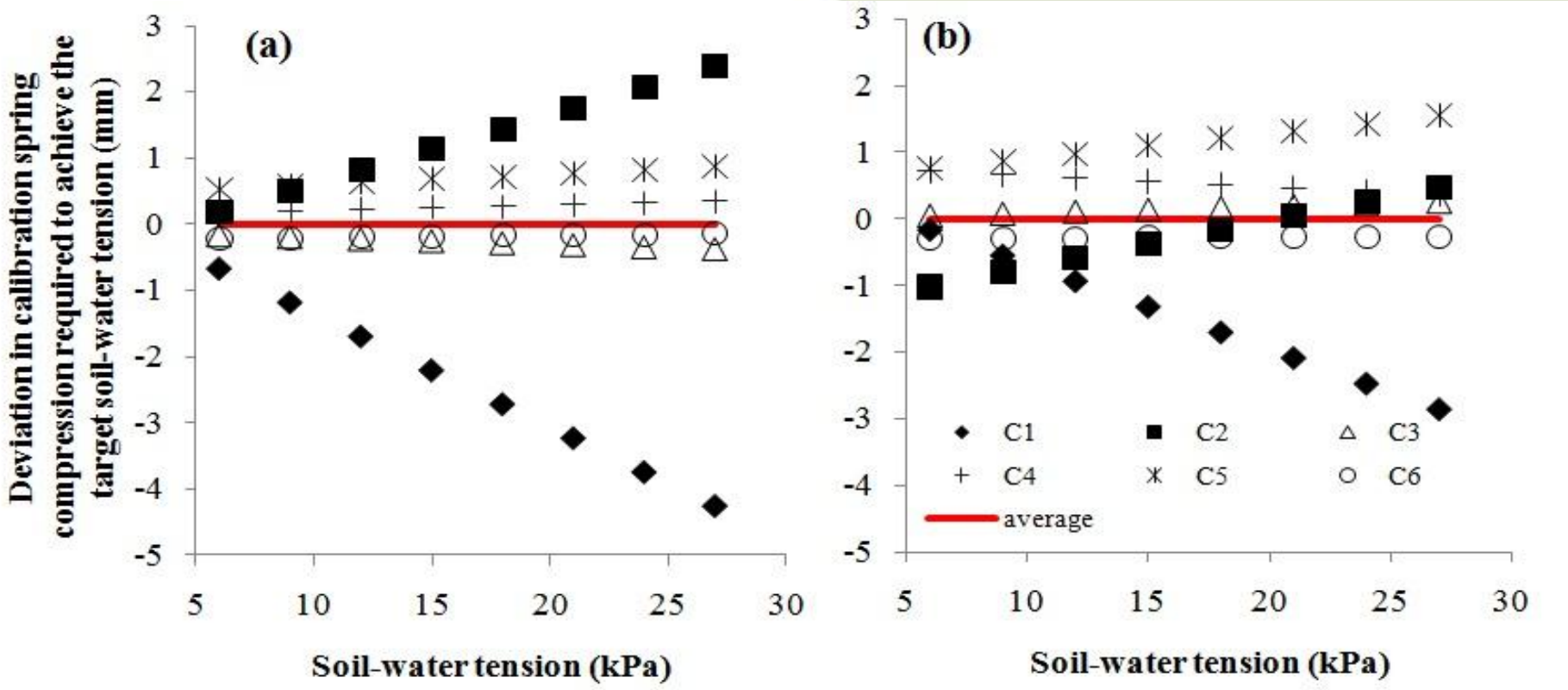
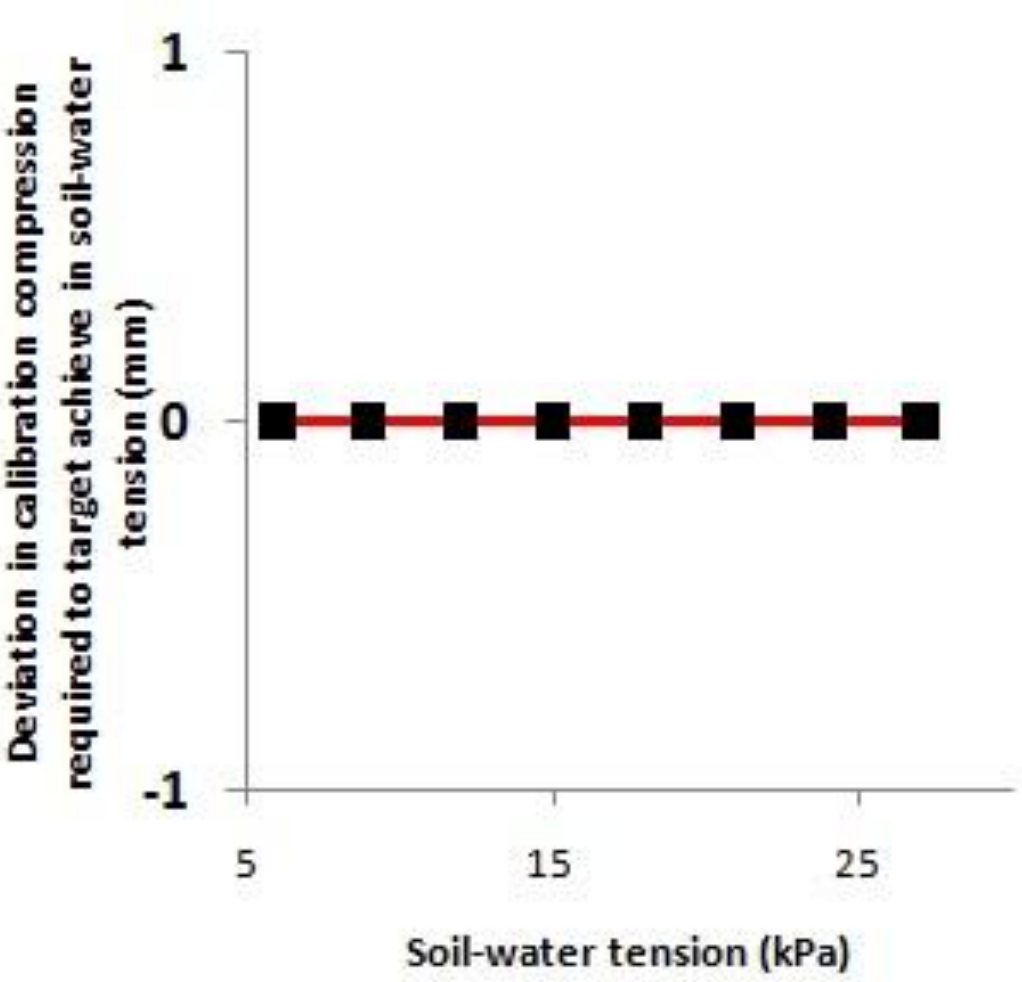
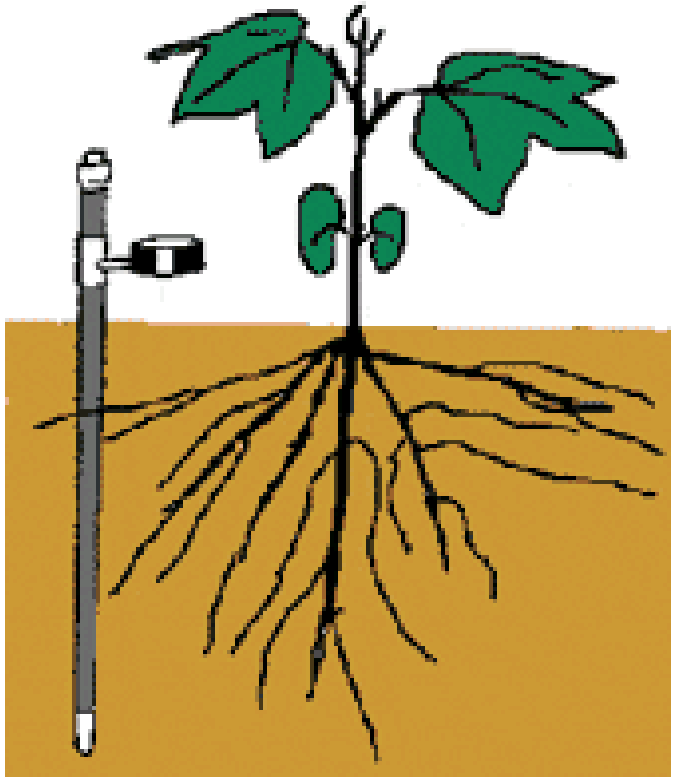


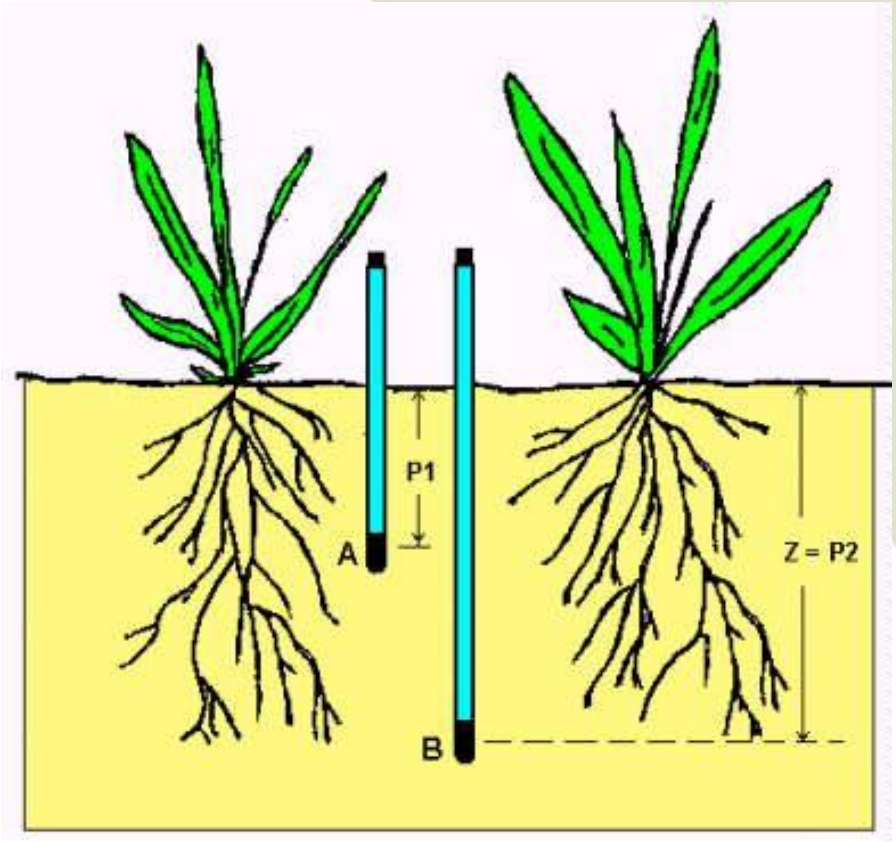

**Fig.** (a) Deviation in calibration compression required to target achieve in soil-water tension in initiate irrigation, (b) Deviation in calibration compression required to target achieve in soil-water tension in cut off irrigation

# Calibration for individual controller

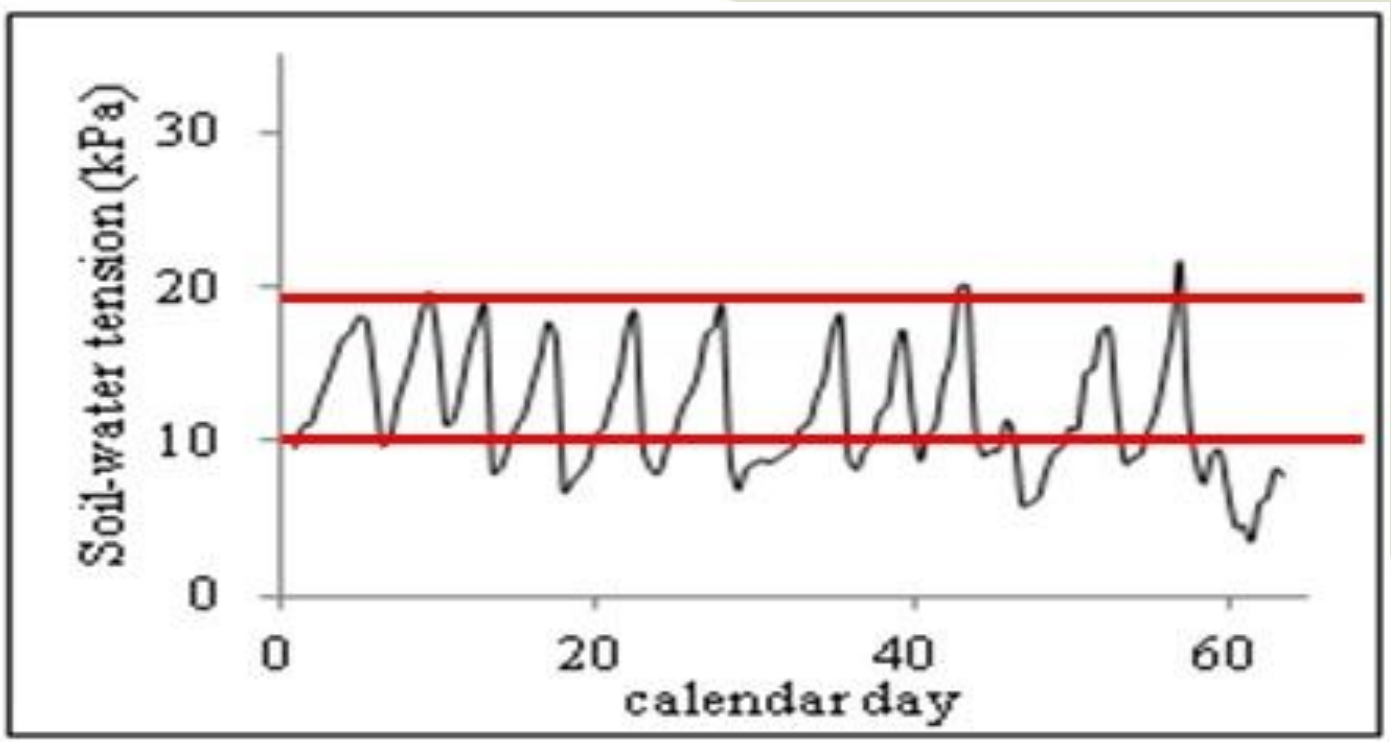



# Single controller versus dual controller

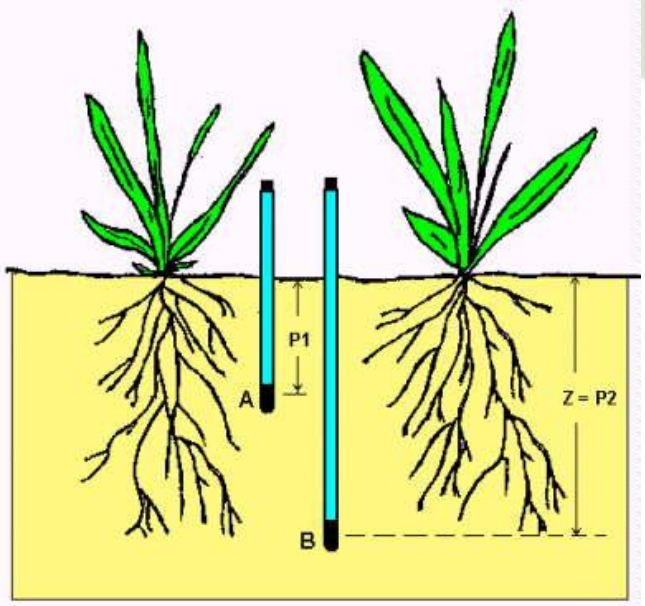


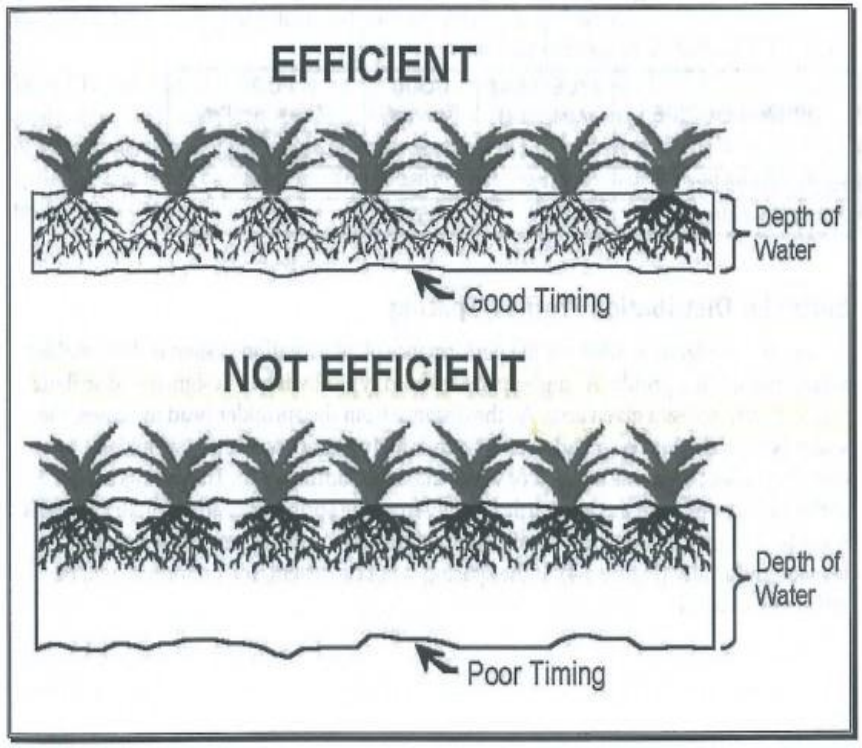


# Irrigation controller performance




**The performance of the irrigation controller is evaluated by it accuracy to initiate and/or terminate irrigation in the preset thresholds and maintain the soil moisture in preset SWT range. However beyond the accuracy of the controller to activate irrigation in specific thresholds some important factors should be taken into consideration.**

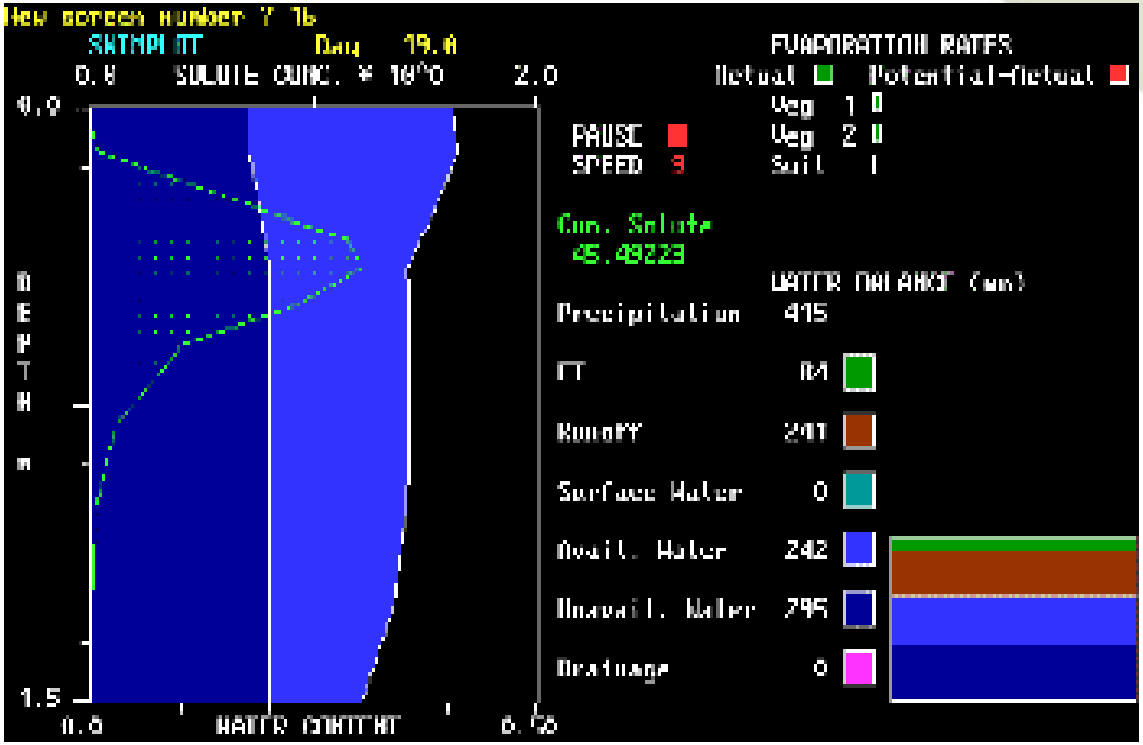



## factors to achieve high performance of irrigation scheduling:

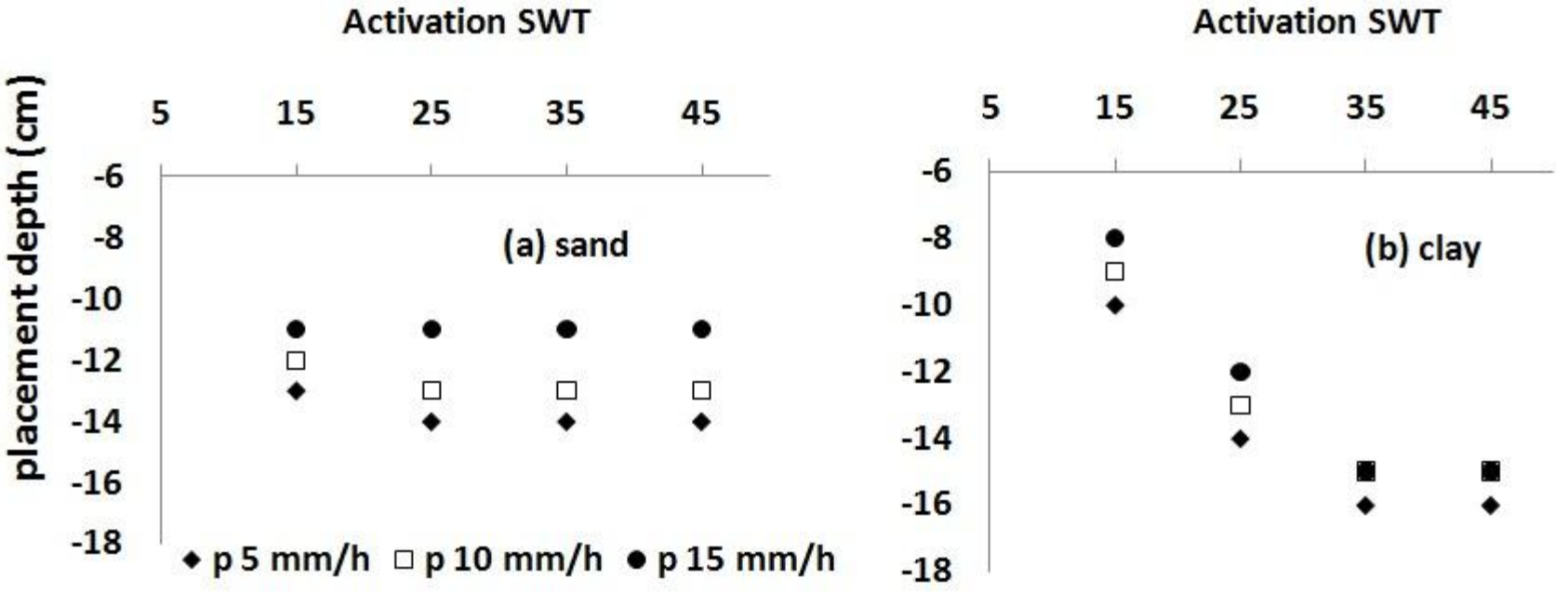
- Sensor location
- Irrigations threshold
- Soil type
- Irrigation rates

# SWIMv2 – Soil water Infiltration movement – CSIRO - Australia




- ✓Richard´s Equation
- ✓Numerical solution
- ✓Validated
- ✓Similar HYDRUS

# Placement depth of irrigation controller




Placement depth of the cut off irrigation controller (SWT cut off 10 kPa) according to Activation SWT and irrigation rates Z=30 cm.

- Higher Activation SWT deeper is placement depth
- Higher Application irrigation rate shallower is the placement depth
- Higher the clay content shallower is the placement depth

# Conclusions

- Mechanically actuated tension control is feasible for irrigation systems.
- Design and manufacture requirements need to ensure repeatability, accuracy and reliability.
- May require individual calibration
- Efficiency dependent on the depth placement, soil and irrigation application system.

# Acknowledge

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