You know:

- Forces acting on water in soil
  - Gravity
  - Matric potential
  - Osmotic potential

You know:

- How to calculate things about water
  - % moisture
  - Moisture content
  - % solids

Learn about water from a plants’ perspective

Plant does not care

- About total moisture
- Plant cares
  - Plant accessible moisture
    - As it requires water
    - As it requires air

For optimal growth

- Plant needs sufficient moisture to meet needs
- Also needs sufficient air
- Plant is concerned with ease of access to both water and air
Four important states of water in soil:

- Saturation
- Field capacity
- Permanent wilting point
- Hygroscopic moisture

**Saturation**

- All water - no air
- Tension = 0 bars, 0 kPascals
- No available air for plants
- Generally short lived state
- Then the loosely held water drains by gravitational flow

**Saturation commonly occurs after major rain event, or as water table rises**

**Field capacity**

- Macropores filled with air
- Micropores filled with water
- -10 - -30 Kpa
- -0.1 - -0.3 Bars

**Field capacity - optimal state for plant grown**
Optimal state for tillage

Permanent wilting point
(Name that soil order)

Wilting point
- - 1500 kPA
- - 15 bars

Field capacity

Clay
Loam
Sand

Volume water content

Water potential

Permanent wilting point
- Still a sizable portion of water in soil
- Matric forces are holding this too tightly for plants to access it

Wilting point

- - 1500 kPA
- - 15 bars
**Plant available water**

**Progression**
- Sufficient moisture for all needs
- As water is used, get to a point where root supply can’t keep up with transpiration demand during day
- Plant will wilt in day, recover at night

**Plants**
- Will remain wilted day and night
- Will die if they don’t have access to additional water

**Hygroscopic coefficient**
- Water film around clays
  - 5 molecules thick
- Water behaves as a solid
- Will sublimate to vapor

**Before they die, what happens to plants when they don’t have enough water?**
- Blossom end rot
  - Ca deficiency
  - Ca usually provided through water
Corn

- Corn does not have any mechanism to stop it from pollinating when it is moisture deficient
- Means that there isn’t enough water for grain fill

Sorghum

- Will not go into reproductive phase unless there is sufficient moisture
- Better crop to grow in potentially moisture deficient conditions

You can measure total moisture....

- Plant available moisture, you need to measure tension
- Tensiometer
- Moisture curves

And then you irrigate

- Dustin Hoffman - plastics
- Sally Brown - irrigation

Irrigation is often vital

- Types
- Amounts

Center pivot
You have 20 g H$_2$O/100 g soil
You want 40 g H$_2$O /100 g soil
- 1 ha of soil
- 15 cm depth
- Bulk density 1.33 Mg/m$^3$

How much soil in the top 15 cm of a hectare?

1 ha x 15 cm x 1.33Mg/m$^3$ x 10,000 m$^2$/ha/(100 cm/m)

\[
\frac{1 \text{ ha} \times 10,000 \text{ m}^2/\text{ha} \times 1.33 \text{Mg/m}^3 \times 15 \text{ cm}}{100 \text{ cm/m}} = 10000 \times 1.33 \times 15 \text{ Mg} = 2000 \text{ Mg}
\]

How much water?
Need 20 g H$_2$O per 100 g soil
Or 20%
2,000 Mg soil x .2 = 400 Mg water

How deep is this? (1 Mg water = 1 m$^3$)
400 m$^3$/ 10,000 m$^2$/ha = .004 m or 4 cm H$_2$O
Then again, sometimes it rains

When it rains

- How much enters soil
  - Infiltration rate
- How much goes over the surface
  - Overland flow
- You want to maximize infiltration

Improve infiltration

- Vegetative cover
  - Slows water
- Macropores
  - Increases flow rate into the soil
- Aggregation
- Lower bulk density

Last thought on soil water

- Sometimes we are concerned with soil water from an environmental perspective