LET'S TALK IRRIGATION
Gravity Fed Drip Systems and Other Options

Presented by AFAC Walter Reed Garden Volunteers

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5/8/2019 – Arlington Central Library Garden Talk

Who we are…

- The Walter Reed Annex Garden grows produce for the Arlington Food Assistance Center under its Plot Against Hunger Program
- Approximately 544 square feet of raised beds & six compost bins
- 1166 pounds of produce delivered to AFAC in 2018
- Relies on volunteers (approx. 750 hours reported for 2018)
  - Core team plans and coordinates
  - Volunteers meet for regular semiweekly work sessions
  - Special projects, such as building new beds is also carried out by volunteers

What we'll cover

- Water Management Practices for the Home Vegetable Garden
- Irrigation Practices at the Walter Reed Garden
  - Gravity Fed Drip Irrigation System with Rain Barrels
  - Role of Irrigation Ollas (Clay Pots) as a Sub-Surface Irrigation Method
- Using Plastic Buckets for Irrigation
  - Sub-Surface Irrigation Planters – Using 4 gal. & 5 gal. Double Buckets to Grow Foodstuff
  - Other Uses of Plastic Buckets for Irrigation

Irrigation as a Water Deposit

Water supports vital plant functions:

- Photosynthesis
- Support / rigidity / turgor
- Transpiration
- Transportation of nutrients and sugars to various plant parts

Vegetables Need at Least 1” of Water per Week

65 gallons per 100sqft

27’000 gallons per acre

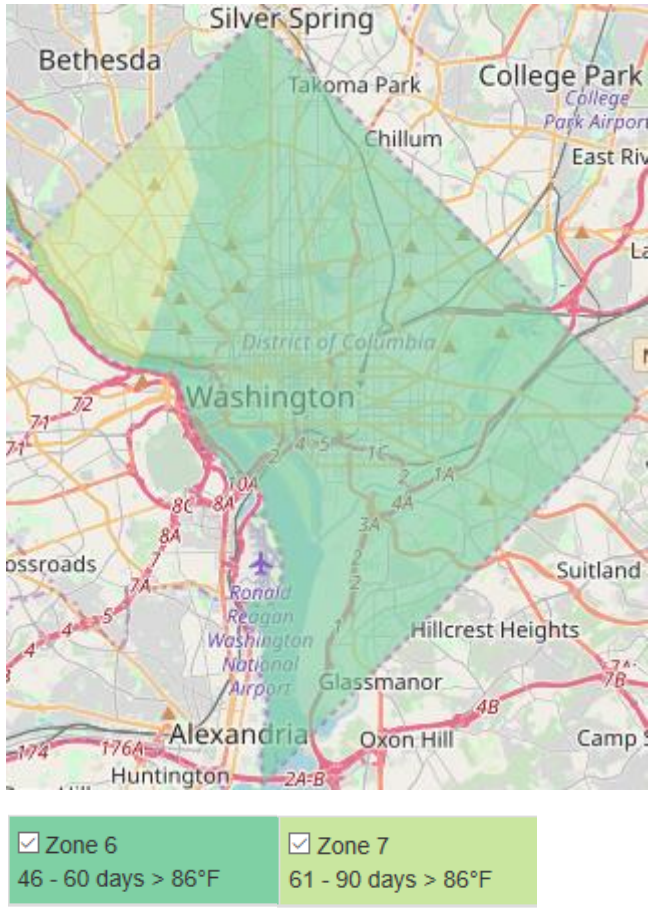
Photo by Francesca York

Manage Irrigation to Supplement Nature in Meeting Plant Needs While Conserving Water

- **Consider Climate**
  - **Your Garden's Microclimate**
    - Sun exposure, heat sources, wind patterns, gardening methods, "effective" precipitations
  - **Number of days >86°F (>30°C) in an average year**
    - American Horticultural Society's Plant Heat Zone
      Zone 6: 40-60 ds/yr and Zone 7: 61-90 ds/yr
  - Average annual extreme minimum temps
    - U.S. Department of Agriculture's Plant Hardiness Zone
      Zone 7a: 0-5°F
- **Consider Soil**
  - Soil types affect drainage and available water capacity
- **Consider Crops**
  - Crops have different and changing water requirements based on root systems, growth stage and varieties

AHS Plant Heat Zone 6 & 7

Number of days >86°F in an average year



http://www.plantmaps.com/

Soil & Water Relationship

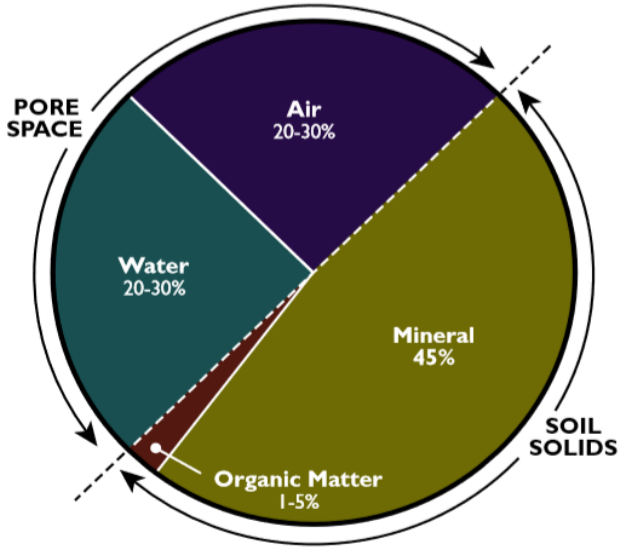
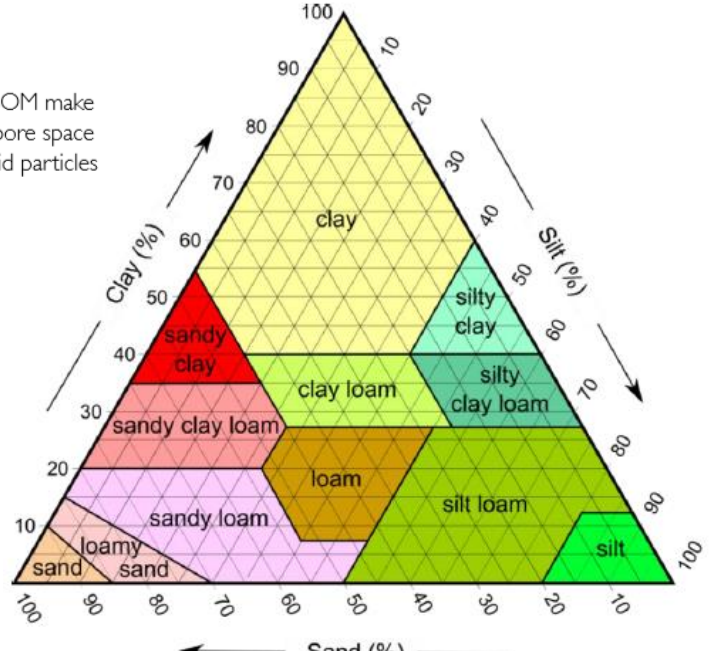
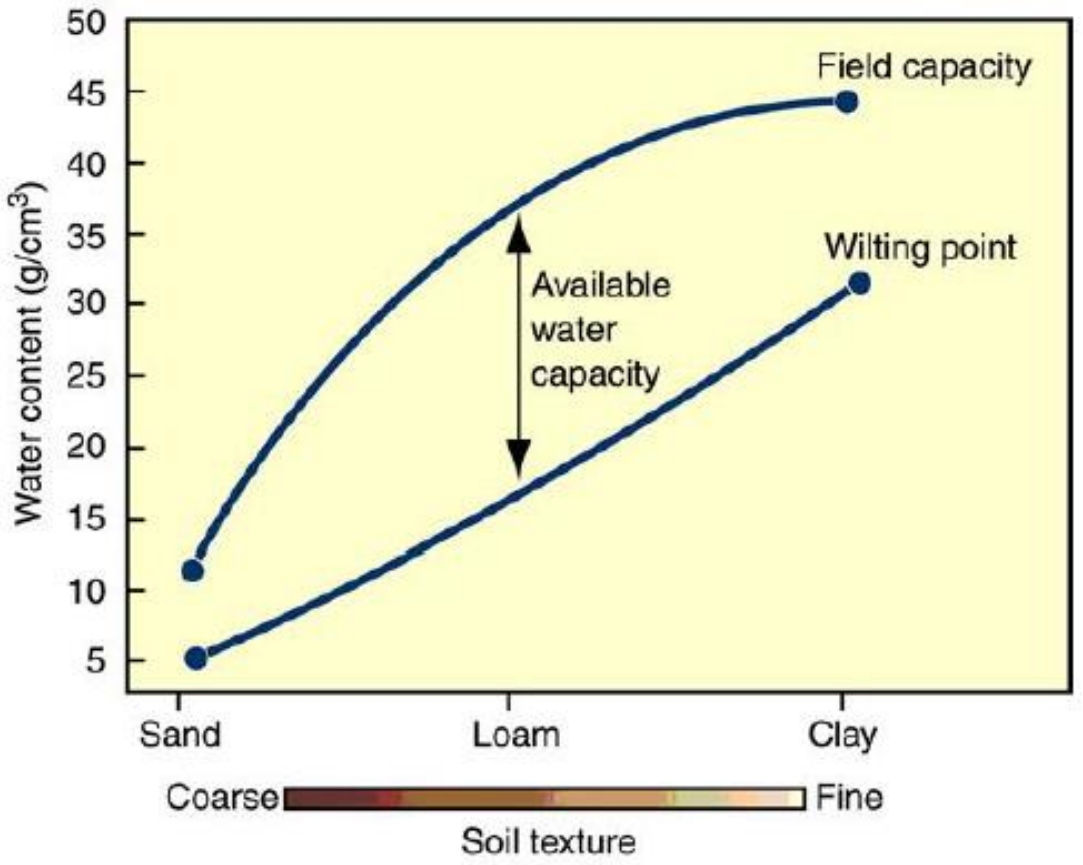
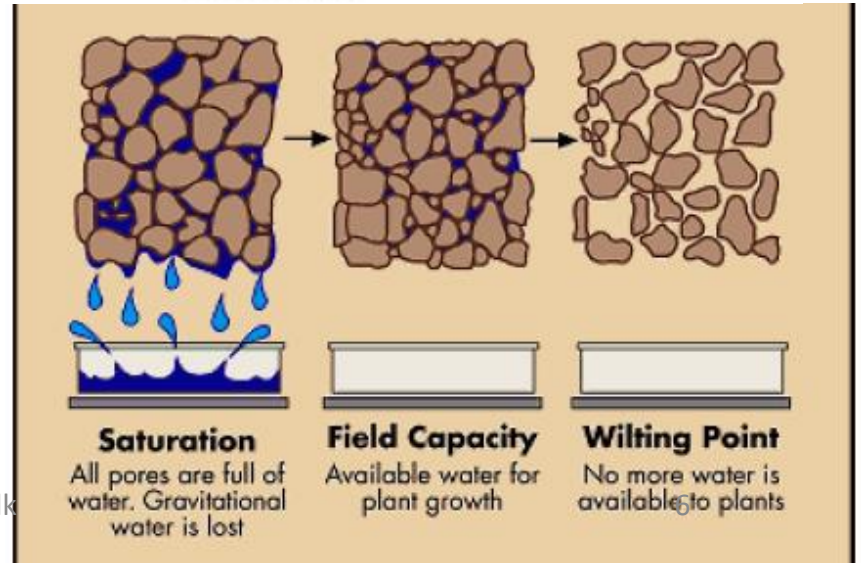


Figure 1. The four components of soil. Minerals and SOM make up the solid fraction, whereas air and water comprise the pore space fraction. A typical agricultural soil is usually around 50% solid particles and 50% pores. (Adapted from Brady and Weil, 2002)





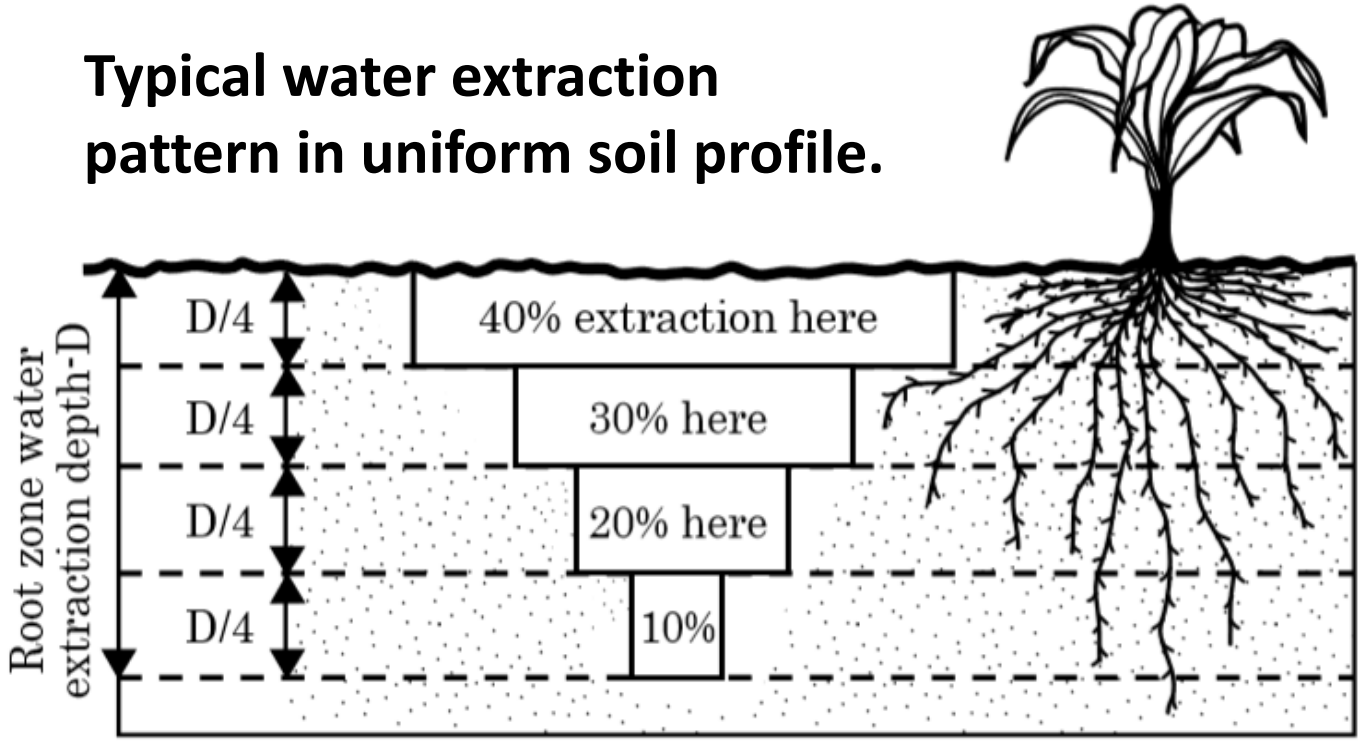


http://**agriculture.vsu.edu**/files/images/special-programs/**water-management-for-raised-bed-gardens-revision**.pdf

https://www.youtube.com/user/kissthegroundca/search?query=soil+story

Soil, Water & Roots

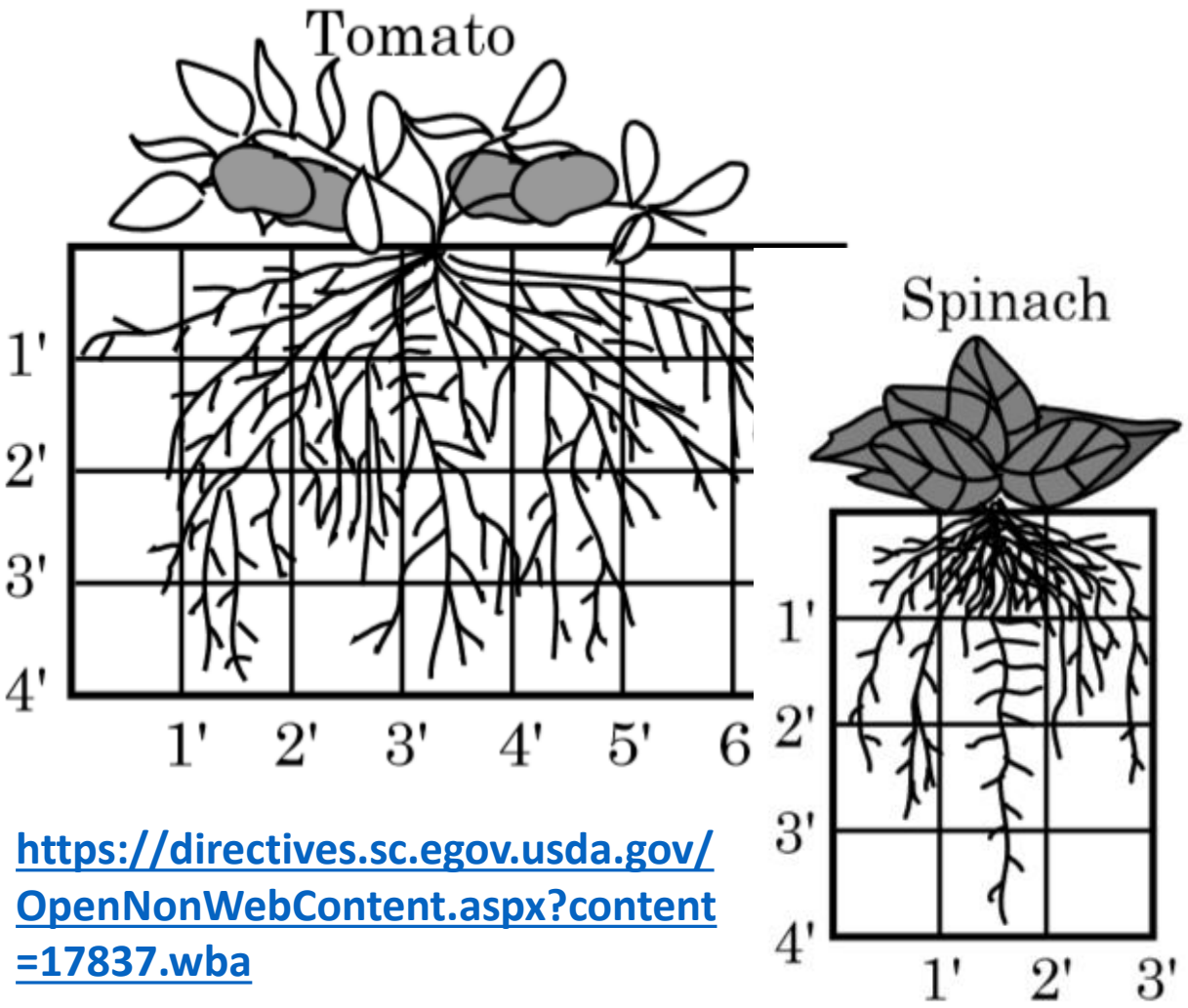
Typical water extraction pattern in uniform soil profile.



Approximately 70 percent of water used by plants is removed from the upper half of the plant root zone.

http://extensionpublications.unl.edu/assets/pdf/g2189.pdf

Root Depth



https://directives.sc.egov.usda.gov/OpenNonWebContent.aspx?content=17837.wba

Table I. Effective root zone moisture depth in unrestricted soils (top 50 percent of root zone).

Truck Crops	*Effective Root Zone Depth (Inches)*	*Truck Crops*	*Effective Root Zone Depth (Inches)*
Asparagus	36	Melons	24
Beets	18	Okra	18
Broccoli	18	Onions, bunch	6
Cabbage	18	Onions, dry	12
Carrots	18	Parsnips	24
Cauliflower	18	Peas	18
Celery	12	Peppers	18
Chives	6	Potatoes	18
Collards	18	Pumpkins	24
Corn (sweet)	24	Radish	6
Cucumbers	18	Rutabagas	18
Dandelion	6	Shallots	12
Eggplant	18	Snap beans	18
Endive	6	Spinach	6
Escarole	6	Squash	24
Fennel	6	Sweet potatoes	18
Horseradish	18	Swiss chard	12
Kale	18	Tomatoes	24
Kohlrabi	18	Turnips	18
Lettuce	6	Watermelons	24
Lima beans	24		

Growth Stage & Crop Specific Requirements

By knowing the critical watering periods for selected vegetables, you can adapt the amount of supplemental water you add.

In general, **water is needed most for**:

- germination of seeds (to 2-4 true leaves),
- immediately after transplanting,
- during the first few weeks of development while roots get established,
- during the development of edible storage organs.

http://msue.anr.msu.edu/resources/blossom_end_rot_tip_sheet

Remember that there is such a thing as "too much water"

Critical periods for selected vegetables:

- Cauliflower: head development
- Cucumber: flowering, fruit development
- Eggplant: flowering, fruiting
- Lettuce: Head development; moisture should be constant
- Melons: Flowering, fruit development
- Tomato: Flowering, fruiting
- Peas: Pod filling

Irrigation Methods for the Home Garden

DOs and Don'ts

- Dispense H_2O at the base of the plants – Avoid wetting the foliage
  - Wetting foliage wastes water and can lead to fungal diseases
- Apply H_2O gently – Avoid splashing or splattering
  - Splattering can lead to soil borne diseases and erosion
- Check and monitor – Don't assume everything is fine
  - Use your finger or a moisture meter in several places

1. **Watering Can**
2. Hose (with some kind of nozzle)
3. **Drip systems**
4. **Sub-Surface Irrigation**
5. Sprinklers (overhead watering is not recommended – early morning)

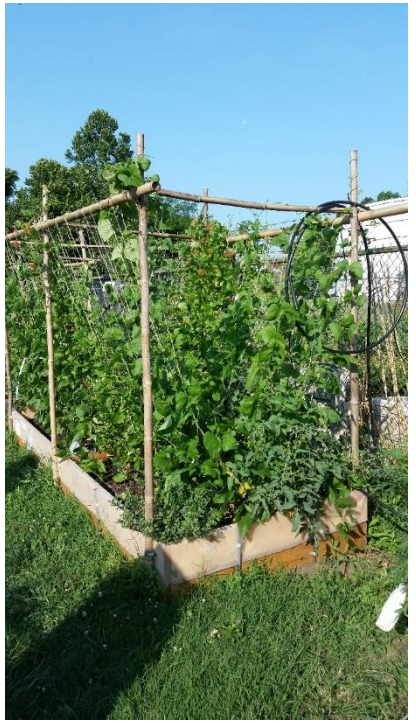
Additional Water Conservation Strategies

COVER YOUR SOIL!

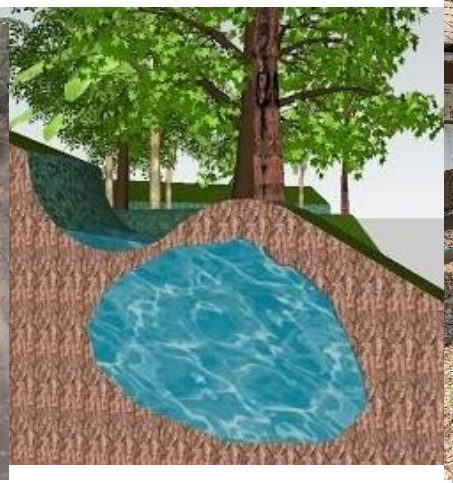
- Mulch
- Cover Crop / green manure
- Under-sow

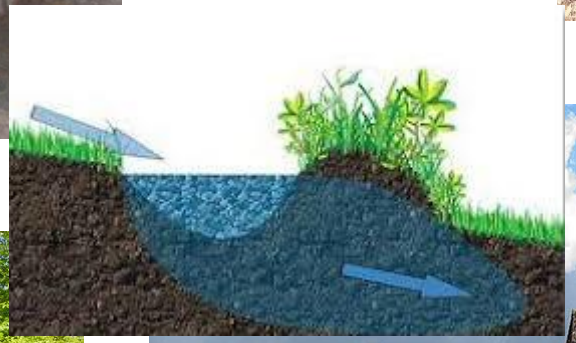
PROTECT FROM HEAT & WINDS

- Wind Breaks
- Shade Cloth



Gardening Methods Affect Water Needs





Irrigation at the Walter Reed Garden

Gravity Fed Drip Irrigation
w/Rain Barrels as Reservoir
+ Ollas for Select Crops

Gravity Fed Drip Irrigation – What Should You Do?

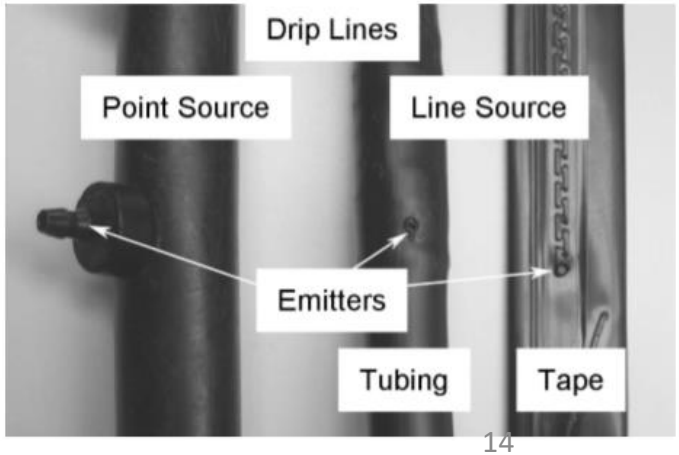
Plan & design based on your unique situation

Consider

- Slope, even if minimal
- Intended crop(s) – crop rotation practices
- Cost
- Level of automation

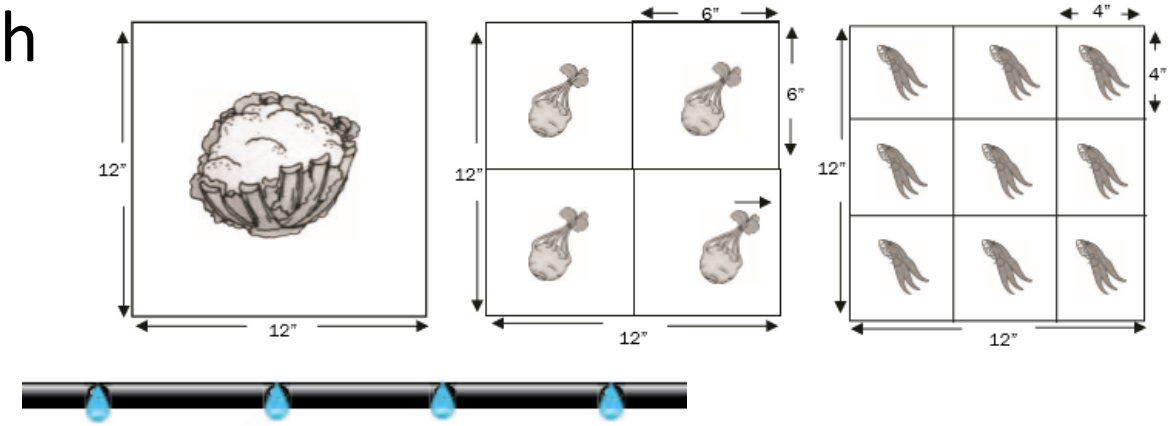
Whatever your choices

- Select equipment designed for low/no pressure
- You will need miscellaneous tools



Gravity Fed Drip Irrigation – How Does Crop Affect Design?

- ½” main line tubing – may be run length or width of the bed to be watered
- Run the branch lines off the main line
  - ¼” soaker driplines come w/built-in emitters spaced every 6”, (9”), 12”
  - Basic drip emitters at end of ¼” tubing water individual plants spaced further than 12” apart (peppers, zucchini, tomatoes)



Gravity Fed Drip Irrigation – What are the Basic Principles?

- System uses gravity to move water – no pump
  - Consider slope of the garden plot *(water will not go uphill!)*
  - Elevate the reservoir *(~12-18" above the top of the raised bed)*
  - Select equipment correctly
- When practical, fill the water reservoir with rain water harvesting techniques
  - Keep the reservoir opening covered with mesh material/screen
  - Top the rain barrel with a collar to collect rain water (alternatively fill with city water)
  - Plastic covers replace collars in summer heat to minimize the growth of algae
  - Build a shed to collect water

Gravity Fed Drip Irrigation w/Rain Barrel Reservoir

Maintain the system

- Keep the filter clean
- Monitor for and remove algae development in the reservoir
- Check soil moisture in multiple locations and keep track of water dispensed
- Troubleshoot problems quickly
  - Check for and fix leaks in the drip system or with the barrel's spigot
  - Check emitters and lines for blockage
- Winterize the system (drain & store)
- Do season-start shores
  - Clean the rain barrels thoroughly
  - Check the lines

Gravity Fed Drip Irrigation w/Rain Barrel Reservoir
Moderately Priced & Effective for Smaller Areas

Keep it simple

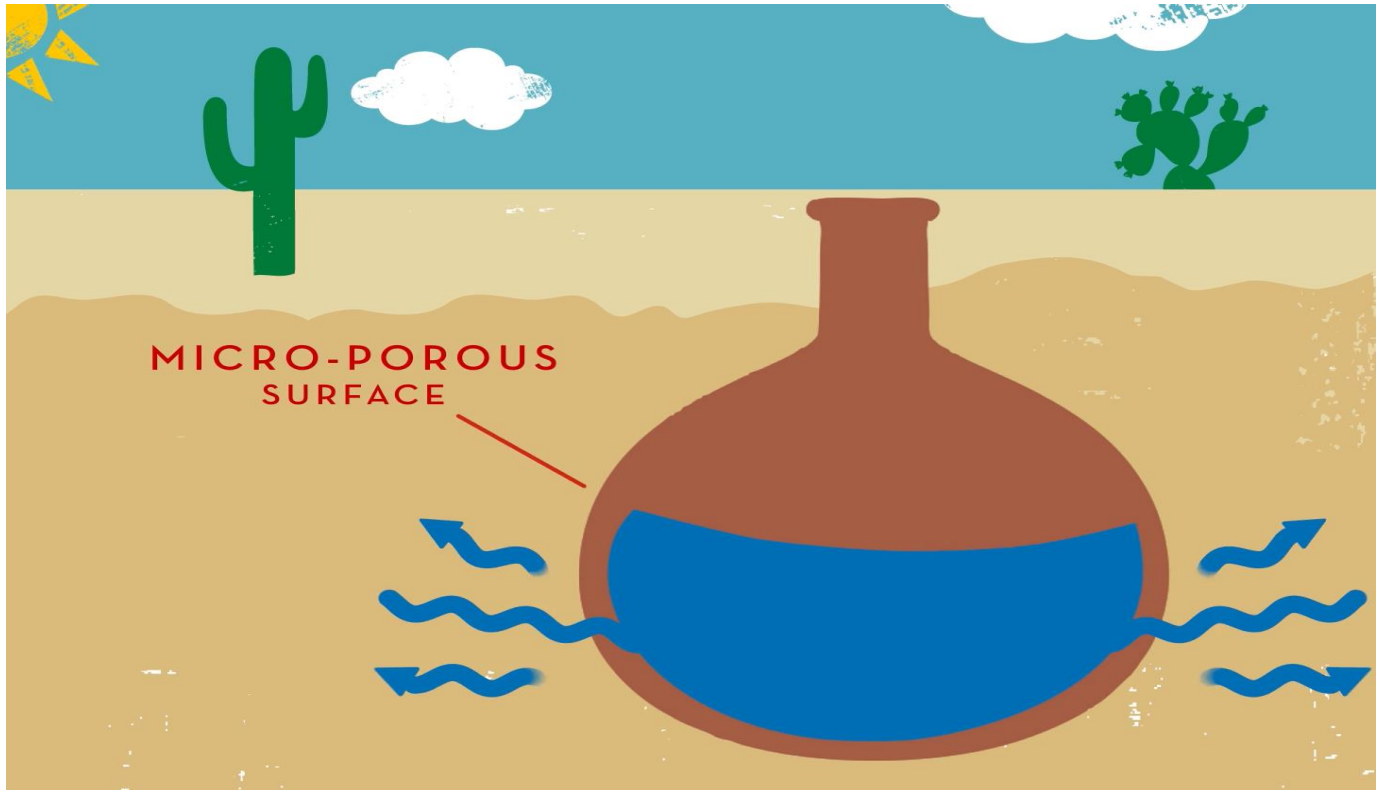
- **A water reservoir** *(1 rain barrel per 4’ x 12’-18’ area)*
- **A structure to support it** *(level cinder blocks stand)*
- **Shut off valve(s)** *(spigot at the rain barrel)*
  - *Optional shutoff valves between irrigation segments within a bed*
- **Timer** (optional) *(type for zero pressure)*
- **Filter** *(screen washer built into timer)*
- **Piping, drip lines & emitters** *(crop dependent)*

Toro 53746

Screen Washer Built Into Timer

Ollas as A Sub-Irrigation Method

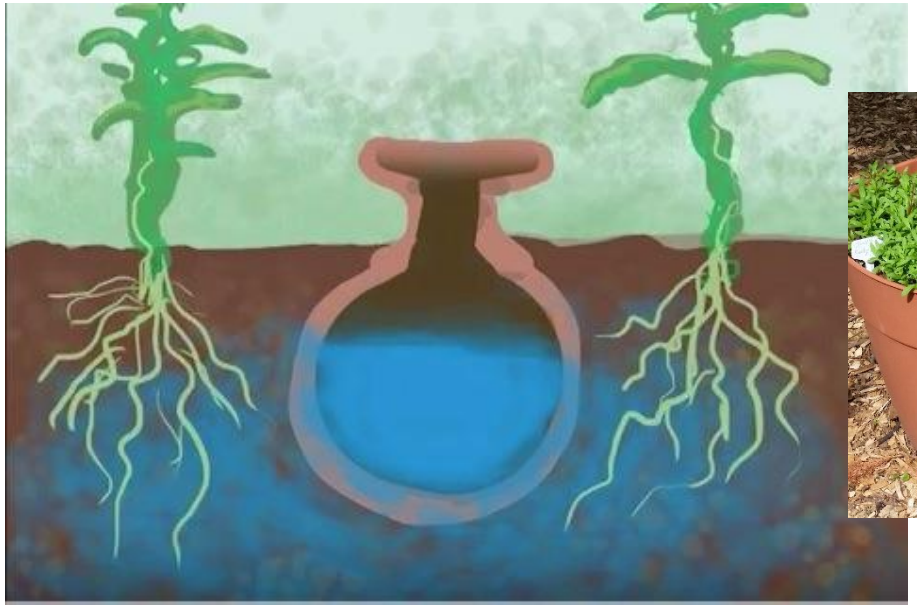
Olla irrigation is the most efficient method for maintaining soil moisture near field capacity and avoiding conditions of saturation or wilting point.

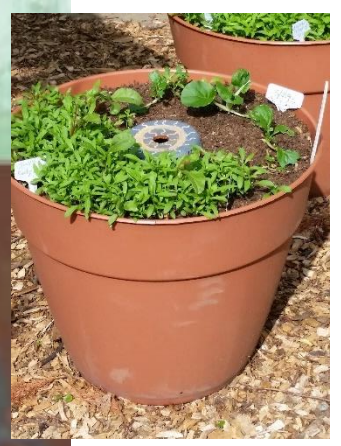


Edible garden plants that have optimum soil moisture exert less energy drawing water and nutrients from the soil, grow faster and are less stressed.

http://www.darrolshillingburg.com/GardenSite/PorousClayCapsuleIrrigation.html

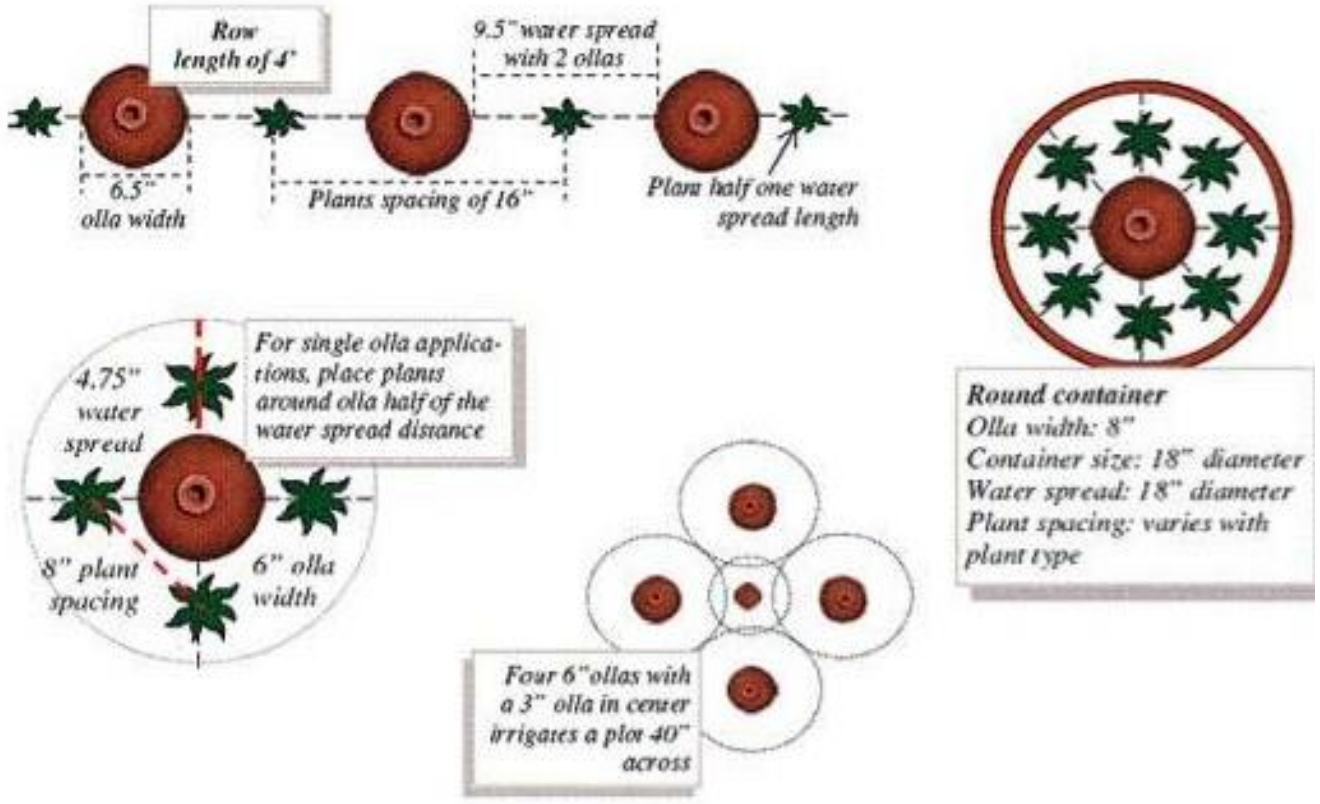
Ollas Take Many Forms, Are Buried in the Soil & Usually Given a Cover

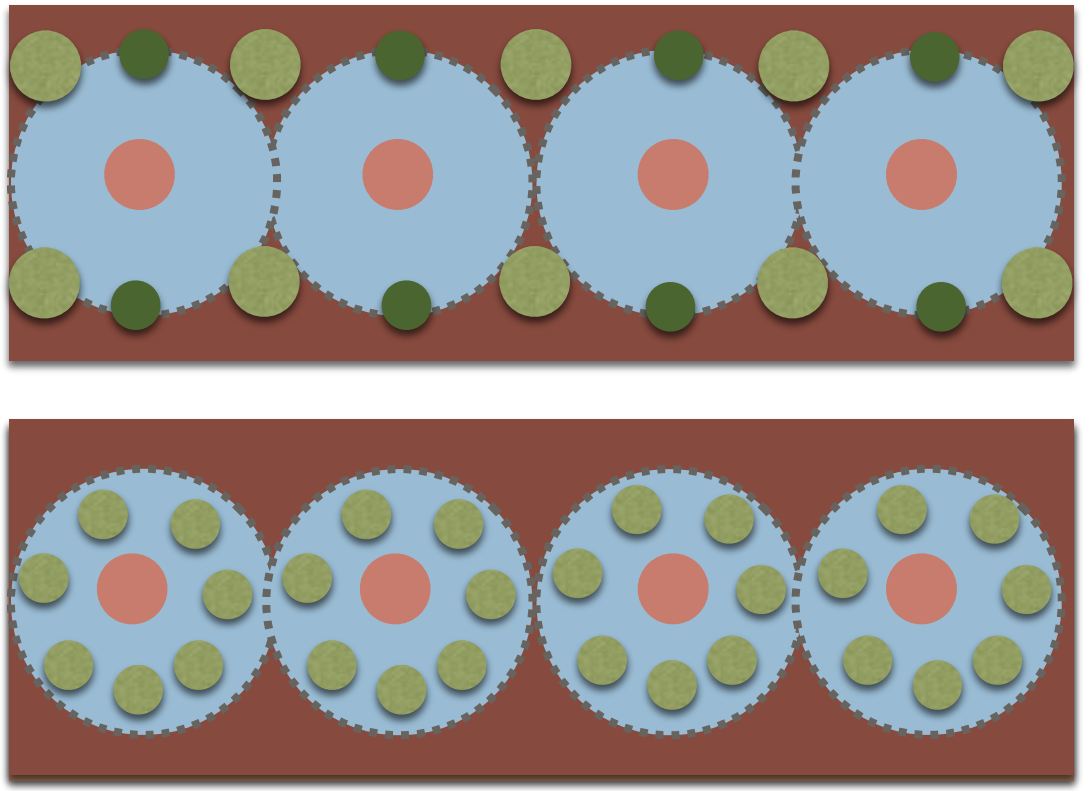




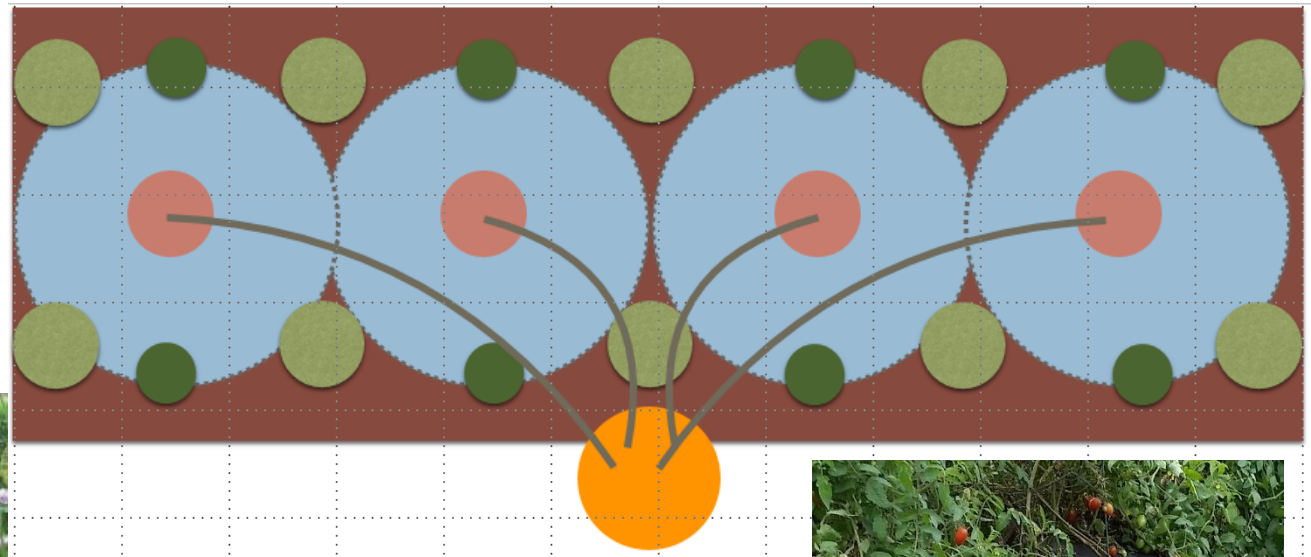
WRG Irrigation Metho[https://images.nativeseeds.org/pdfs/Ollairrigationhandout.pdf

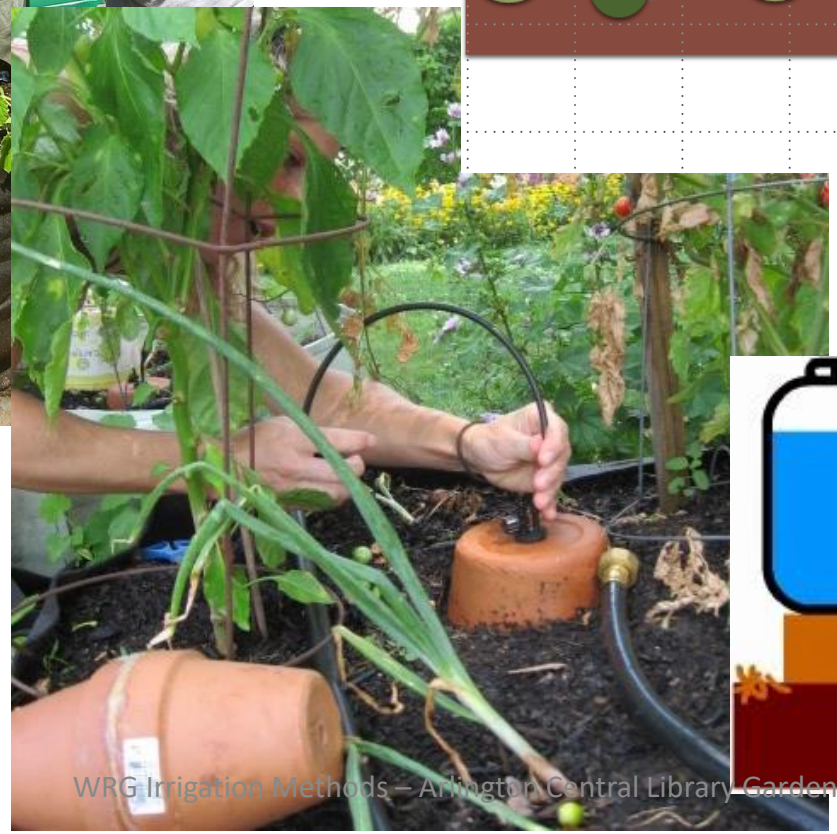
Ollas Are Organized to Reach Plants Around Them

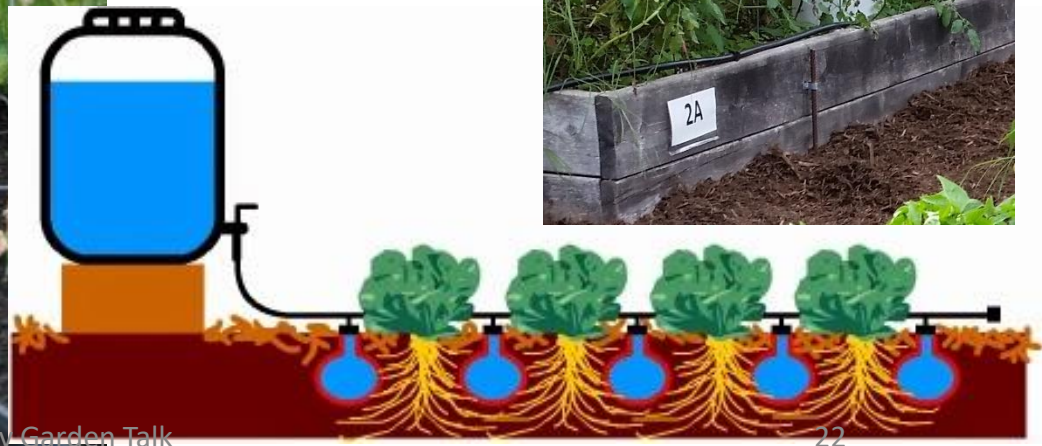




Ollas Need To Get Filled on A Regular Basis





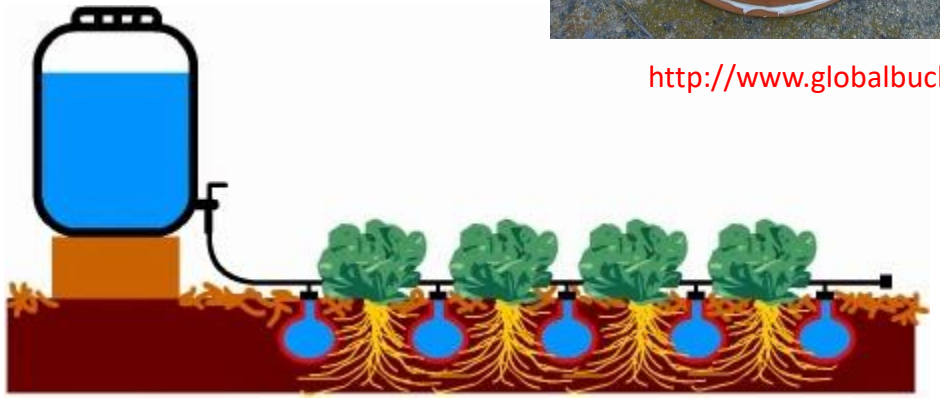


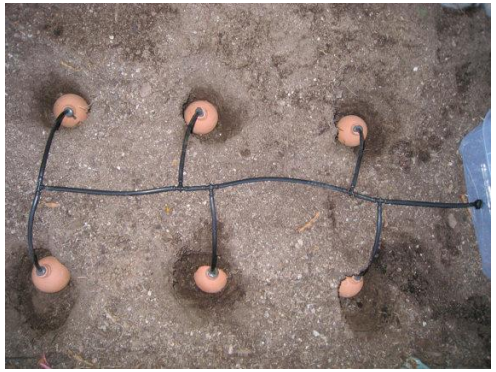
You Can Automate Olla Irrigation

http://www.globalbuckets.org/

Walter Reed Garden plans to experiment with this

- Build smaller, fully sealed ollas.
- Connect them to a water source.
- Such pots can be completely buried.
- Have gravity fill the ollas.
- Replenish the water source container.





Thomas Bowes on YouTube

https://www.youtube.com/watch?v=mDn7vWwrYEc

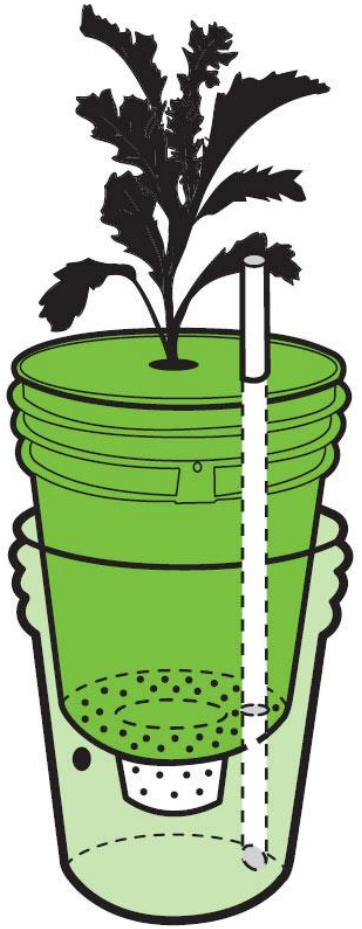
https://www.youtube.com/watch?v=j0pwF-3VriA

https://www.youtube.com/watch?v=s0BryMMFwME

Double Buckets as A Sub-Irrigation Method

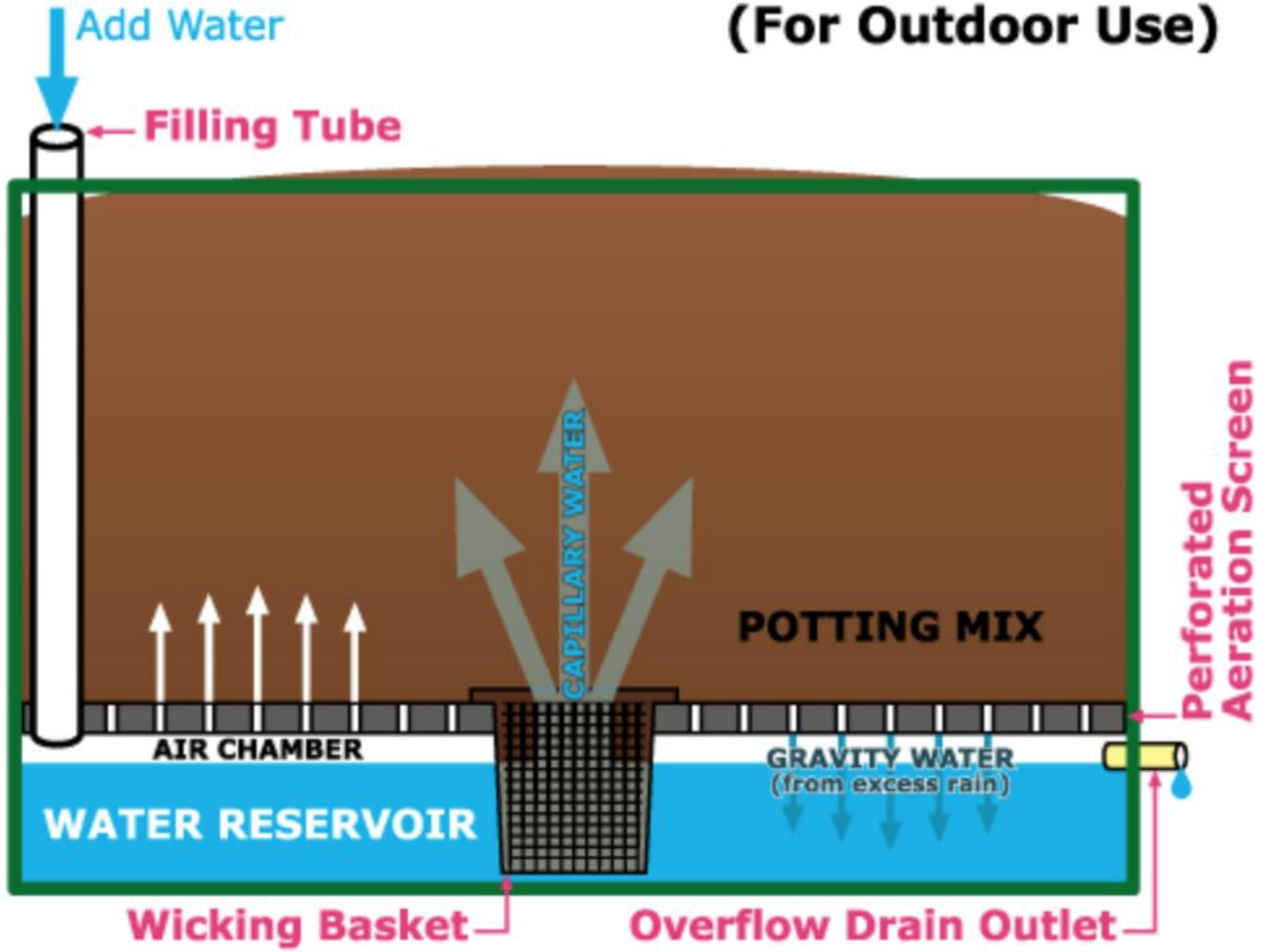
Sub-surface Irrigation Planters (SIPs)

- Rely on wicking and osmosis to provide plants with adequate moisture directly at the roots.
- The top/inner bucket serves as a planter while the bottom/outer bucket serves as the reservoir.
- Sometimes (erroneously) named “self-watering” these planters can come in many different sizes.
- SIP can also be made with one container, where the water compartment is isolated from the planter segment by some kind of barrier.



https://en.wikipedia.org/wiki/Sub-irrigated_planter

Sub-Irrigated Planter
(For Outdoor Use)



- **Water Tight Container**
  - Plastic or Plastic Lined
  - Avoid Uncoated Ceramic
- **Peat Based Potting Mix**
  - Coir or Fine Pine Bark can be included
  - Add extra Perlite for aeration
  - Fertilize with granular fertilizer
  - Add Dolomitic Lime
- **Filling Tube**
  - PVC Pipe or Water Bottles
- **Perforated Aeration Screen**
  - Holes are needed for oxygenation of roots
  - Corrugated/Perforated Drain Pipe will work
  - or Perforated Recycled Plastic Containers
- **Overflow Drain Outlet**
  - Hole MUST be placed below Aeration Screen
- **Wicking Medium**
  - Porous Basket Filled with Potting Mix
  - Polyester Cloth or Cord

Potatoes

Swiss Chard
& Carrots

Peppers

Eggplants

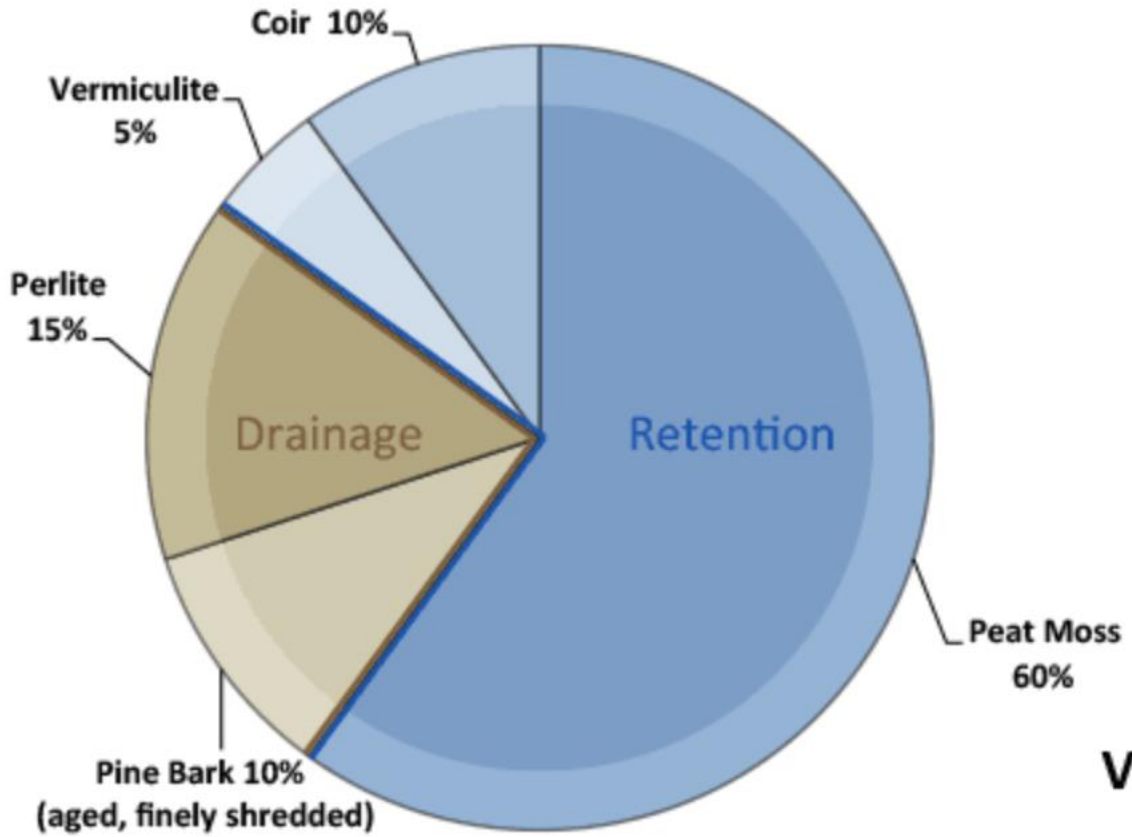
YOU CAN GROW MANY THINGS IN A FOUR GALLON DOUBLE BUCKET!!!

Tomatoes

Bush Beans

SIP POTTING MIX SAMPLE RECIPE

(from base components)



COMPONENT OPTIONS

RETENTION (70-80%):

Peat Moss (strong wicking properties; pH may be acidic - adjust with dolomite.)

Coir / Coco (renewable: coconut husk fiber)

Vermiculite (high cation exchange silicate)

DRAINAGE (20-30%):

Perlite (expanded volcanic rock)

Growstones (made from recycled glass)

Fir / Redwood / Pine Bark Mulch (Dark outer bark - NO heartwood or sapwood)

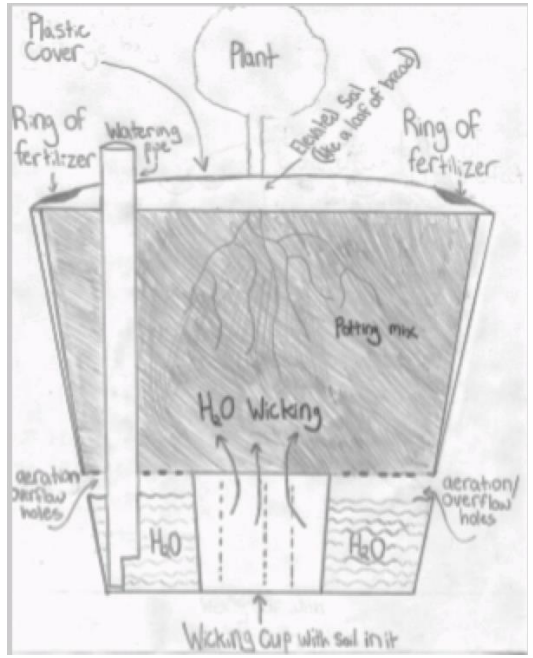
ADDITIONAL MATERIALS:

Dolomitic Lime (calcium + magnesium)

Vegetable Fertilizer (macro + micronutrients)

Tips for Success with Double Buckets

- Select plants suitable for container size (e.g., “patio” / smaller varieties
- Locate outer bucket drainage holes so that there is air space above water level
- Keep the water receptacle full / Ensure soil wicks H_2O throughout
- Ensure crop gets necessary water until root establishment
  - Manually water until germination or seeds begin growth
- Consider plastic cover to limit evaporation once established
- Plants in containers need food too!
  - liquid fertilizer can be added to reservoir
  - slow release fertilizer can be added to top under cover



www.globalbuckets.org

Small Scale Drip Irrigation & Fertigation on the Cheap

Use a bucket to dispense water or soluble fertilizer to individual plants

- Connect ¼” line directly to bucket
- Add an emitter at the end of the line
- Alternatively, install a hose-pinching valve to regulate the flow to a trickle
- Elevate the bucket to just above the location to be watered or higher
- Cover the bucket / rinse well after fertigation

Herrick Kimball – Planet Whizbang Blog
By a hardware kit at:
http://bucketirrigation.blogspot.com/

Resources

Arlington Food Assistance Center, Plot Against Hunger Program – https://afac.org/plot

Arlington Central Library, 1015 N Quincy St, Arlington, VA 22201

- Garden Talks – Wednesdays 7pm-9pm – March through October

Master Gardeners of Northern Virginia – https://mgnv.org/

- Virginia Extension / MGNV Classes in Arlington and Alexandria (Events)
- Kitchen Gardening Resources & Between the Rows Newsletter (Resources)

Gardeners…

- Volunteer at a Giving Garden
- Enjoy the Company of Other Gardeners

This presentation & additional irrigation resources

- Posted to Dropbox at https://goo.gl/zDDy8h