

Water-Wise Vegetable Gardening

Stephanie Walker, Ph.D.

Extension Vegetable Specialist

Vegetables

- Healthful, low calorie, and critical component to the human diet
- Provide many essential vitamins, minerals and fiber
- However, vegetable crops are mostly composed of water (80-95% on average)



Growing Water-Wise Vegetables

Three Approaches:

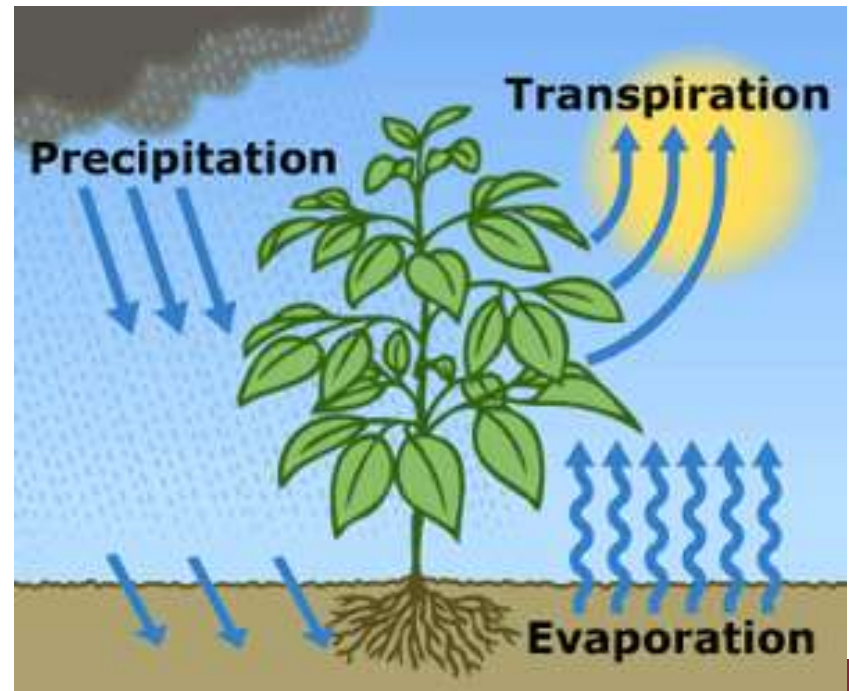
- 1) Modify the environmental conditions to minimize water loss to evaporation and leaching
- 2) Manage growth of vegetable plants for minimal supplemental water needs
- 3) Plant vegetables that need less water to produce a crop

Water-Wise Vegetable Gardening

MODIFY THE GARDEN ENVIRONMENT

Transpiration

- Loss of water by a growing plant
- Critical for cooling, nutrient uptake, and turgidity
- Increased rate with
 - high air temperature
 - low relative humidity
 - windy conditions
 - sunlight



<http://ga.water.usgs.gov/edu/graphics//evapotranspiration.gif>

Transpiration

- Drought resistant plants reduce transpiration through
 - Heavy cuticle
 - Small leaves
 - Less leaf area
 - Spines or hairs on leaves
- Most vegetable plants are not drought tolerant



How do we minimize transpiration rate in vegetable plants?

- **Increased** rate with
 - high air temperature
 - low relative humidity
 - windy conditions
 - sunlight
- **Reduce rate** with
 - wind protection
 - shading



Control Weeds

- Weeds compete with vegetable crops for water, as well as nutrients
- Weeds also frequently harbor diseases that will harm your vegetable plants



Control Weeds

- “Plants growing where you don’t want them to grow”
- Don’t allow weeds to go to seed!
- Control by:
 - Mechanical removal
 - Mulch
 - Herbicides
 - Targeted water application



Know your soil

- Soil type affects frequency and duration of watering

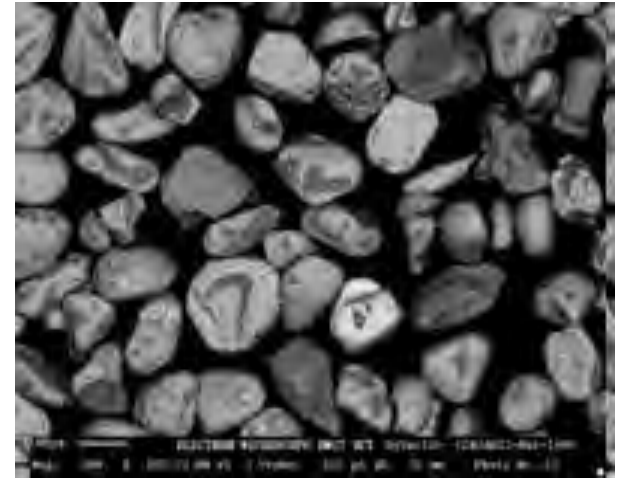


Photo Courtesy of Netafim

Soil Texture

- Coarse textured soils (high % sand)

- Good drainage and tilth
- Hold very little water
- Minerals readily leached



<http://www3.imperial.ac.uk/pls/portallive/docs/1/7290187.JPG>

- Needs more frequent, ‘lighter’ watering

Soil Texture

- Fine textured soils (high in silt and/or clay)
 - Poor drainage, hard to manage
 - Hold soil water tightly
 - Bind more nutrients
 - In general, needs less frequent watering



http://www.semp.us/_images/biots/Biot226PhotoF.jpg

Prepare Soil to Maintain Moisture

- Best soil is deep, well drained & contains plenty of organic matter
- Organic matter holds soil moisture
Example: Sponge vs. Gravel



- Most soil in NM is very low in organic matter
- Increase through regular addition of compost, manure, organic mulch

Mulch

- Material placed on soil surface around vegetable plants
- How to apply
 - Once plants are established, cover ground 2-4"
 - Don't cover vegetable plants



Mulching

- Pros
 - Conserves soil moisture
 - Keeps weeds at bay
 - Keeps fruit off ground
- Cons
 - Could harbor pests
 - Labor and cost investment
 - Wind



Mulch

- Organic types

- Straw, leaves, wood chips, newspaper, pecan shells, compost

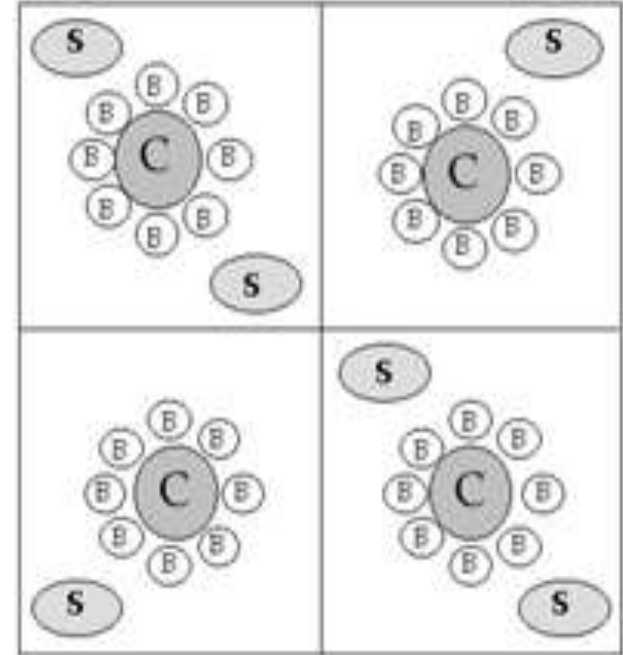
- Plastic mulch

- Excellent for preserving soil moisture and inhibiting weed growth

- Doesn't add to soil organic matter and creates disposal issue

Zuni Waffle Garden

- ‘Three sisters’ planting for dry conditions
- Waffles are approx. 12’ x 12’
- Each individual square is indented and surrounded by a high rim
- Allows maximum water efficiency in arid, southwest climate



Water-Wise Vegetable Gardening

VEGETABLE PLANT MANAGEMENT

Water

- The vast majority of vegetable crops grown in New Mexico will require supplemental irrigation
- Controlled application can aid in vegetable management for drought tolerance



Water Requirements Through the Season

Know your plants, including critical windows for optimal watering

- Germination and transplant establishment periods are always critical
- Critical water stage for most vegetables is while consumable part is growing
- 'Fruiting' vegetables (tomato, chile peppers, melons) is at flowering and fruit set

Encourage Deep Root Growth

- The deeper the roots, the better a plant can hold up to drought stress
- Less frequent, deep watering encourages
- Water slowly to let moisture percolate
- Some vegetables naturally have shallow roots so wouldn't benefit: Onions, Lettuce
- Deep rooted vegetables include:
Asparagus, Squash, Tomatoes

Deliver Water Directly to the Roots

- Sprinklers and flood irrigation are *least* efficient
- Drip irrigation and soaker hoses are *most* efficient
- Water early morning or at night to minimize evaporation



Water

- Many gardeners provide more irrigation than needed
- Too much water can also stress or kill plants
 - Water-saturated soil can ‘smother’ roots
 - Many soil borne diseases thrive in overly wet soil
- Watch for wilting, plant stress

Irrigation

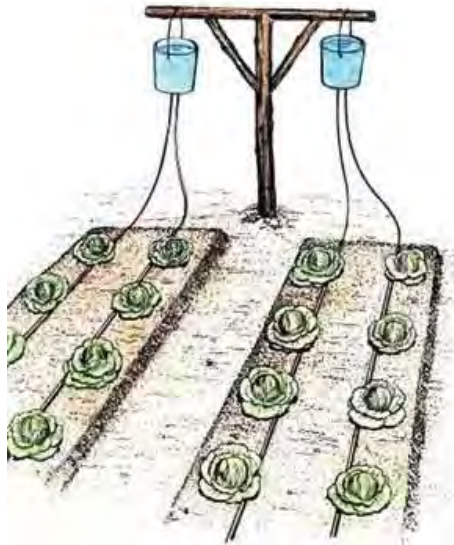
- Check soil moisture regularly
 - Irrigate when top two to four inches is dry to the touch
- Automate the system with controllers
- 1 inch of water in a 1'X 1' space is a little over half a gallon



<https://www.pinterest.com/explore/irrigation-systems/>

Irrigation Systems

- Sprinkler
- Drip
 - Tape
 - Emitter
 - Low pressure
- Soaker Hose
- Flood



Check Your Flow Rate

- Measure the amount of water coming out of your spigot or valve
 - Time it takes to fill a five gallon bucket



Vegetable Water Application

- In general, approximately 1 inch of irrigation water is applied to vegetables weekly (about 1/3 inch every other day, depending on soil type and other factors)

Don't Water 'Dirt'!

- Avoid applying water to surrounding soil away from roots
 - At best - soaks into ground away from root zone
 - At worst - initiates weed growth

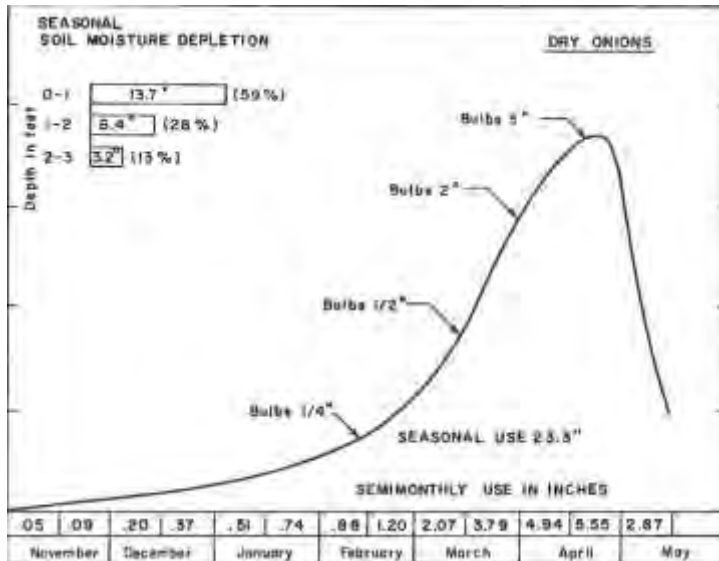


Water-Wise Vegetable Gardening

PLANT VEGETABLES THAT NEED LESS WATER

Consumptive Use of Water

- Quick maturing vegetable crops typically have less total irrigation needs
 - Bush (determinate) vs. Vining (indeterminate)



<https://cals.arizona.edu/crops/irrigation/consumuse/conusefinal.pdf>

General Water Requirements

- Tomatoes, Eggplants, and Peppers
 - Need most water during flowering and fruiting
- Vine Crops (cucumbers, summer and winter squash, and melons)
 - Need most water during flowering and fruiting
- Carrots, Onions, Lettuce
 - Need consistent water throughout the season
- Sweet corn
 - Need the most amounts of water to produce quality crops

Low Water-Use Vegetable Crops

- Tepary Beans
- Black-eyed Peas (Cowpeas)
- Okra
- Asparagus
- Squash (some varieties)
- Tomatoes (some varieties)

Tepary Beans (*Phaseolus acutifolius*)

- Native to the American Southwest where they've been a staple crop for thousands of years
- From the Papago Indian phrase "t'pawi", meaning "it's a bean"
- Small beans in a wide variety of colors



Photo credit Native Seed/SEARCH

Cowpeas

- Black-eyed peas, as well as many other types
- Immature beans can be eaten like green snap beans
- Most produce long vines; allow 3-5' between rows



http://en.wikipedia.org/wiki/Black-eyed_pea

Cowpeas (*Vigna unguiculata*)

- Originated in Africa
- Need little water to grow; grow poorly if watered too much
- Thrive in high heat



<http://www.rareseeds.com/store/vegetables/cowpeas/>



Baker Creek Heirloom Seeds

Okra (*Abelmoschus esculentus*)

- Member of the mallow family (Malvaceae), closely related to hibiscus and cotton
- Origins in northern Africa
- Grown for their immature pods
- Known for glutinous consistency (gumbo)

<http://www.graphicpenguin.com>



Okra Planting

- Okra plants prefer humidity and heat
- Well-drained, fertile soil is optimum
- Intolerant of prolonged wet soil
 - Plant in areas with good drainage
- Plant when soil is warm ($> 60^{\circ}\text{F}$)



Asparagus (*Asparagus officinalis*)

- Tolerant of heat, drought and salinity
- Perennial; productive for many years
- Dioecious
 - male and female plants
- Modern varieties all male for higher yield



<http://en.wikipedia.org/wiki/Asparagus>

Asparagus

- Wild asparagus near the Rio Grande



The Cucurbits: Pumpkins, Squash and Gourds

<i>Cucurbita</i> Species	Pumpkins	Summer Squash	Winter Squash	Ornamental squash
<i>C. pepo</i>	Pie, Miniatures	Crookneck, Zucchini	Acorn, Fordhook	Gourds
<i>C. maxima</i>	Jack O Lantern		Hubbard, Banana	Turban
<i>C. moschata</i>	Crookneck pumpkins		Butternut	
<i>C. argyrosperma</i>	Cushaw		Cushaw	

Squash: *Cucurbita argyrosperma*

- *C. argyrosperma*: Includes 'Cushaw', many of the best tasting pumpkins and squash
 - Requires a long, warm growing season
 - Many are grown for their edible seeds
- *C. argyrosperma* varieties:
 - 'Tennessee Sweet Potato',
 - 'Hopi Cushaw'



Squash: *Cucurbita moschata*

- *C. moschata*: Includes the butternut and “cheese pumpkins”
 - Require 1-2 week curing
 - Some varieties will hold even longer than *C. maxima*
- *C. moschata* varieties: ‘Waltham Butternut’, ‘Long Island Cheese’

'Seminole Pumpkin' (*C. moschata*)

- Cultivated by the Seminole Indians in Florida
- Large, spreading vines
- Fruit with long shelf-life



<http://www.southernexposure.com>

Squash: *Cucurbita maxima*

- *C. maxima*: Includes many of the winter squash varieties
 - Many require a month storage indoors to cure
 - Some will keep for several months and may develop improved flavor

C. maxima varieties:
Kabocha, Buttercup,
Hubbard



Red Kuri Squash (*C. maxima*)

- Also called 'Baby Red Hubbard'
- Thick-skinned, orange colored, winter squash
- Delicate, chestnut-like flavor
- Drought tolerant



Squash: *Cucurbita pepo*

- *C. pepo*: Includes most of the summer squash, and small to medium-sized ornamental pumpkins
 - Require 1-2 week curing
 - Most do not keep well after curing
- *C. pepo* varieties: Zucchini, Spaghetti, Acorn, Delicata

Summer Squash

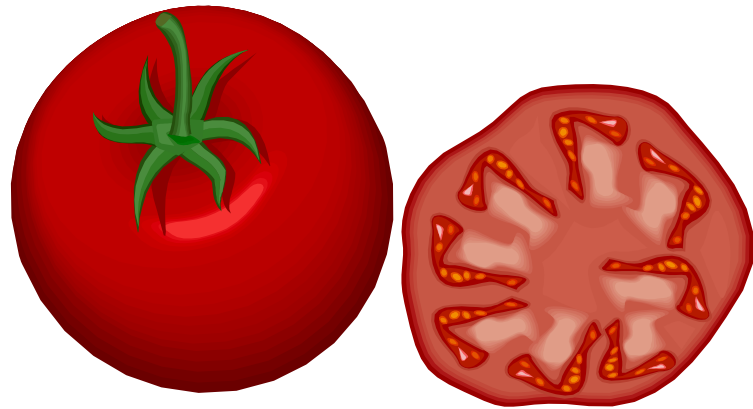
- Zucchini (*C. pepo*) cultivar 'Dark Star'
-bred for deep, penetrating roots for drought tolerance



<http://www.seedsofchange.com>

Tomato Cultivars

- Drought-tolerant varieties:
 - Pineapple
 - Yellow Pear
- Look for early maturing types



Drought Tolerant Cultivar Selections: Tomatoes

- **'506 BUSH'**
 - Bright red fruit grows on strong vines that reach only about 18 inches tall.
 - Plants are drought tolerant and yield well. Determinate. 62 days.
- **'Celebrity Tomato'**
 - Hybrid, determinate, 70 days, red, globe (8-12 ounces)
 - 1984 All-America Selections Award Winner
- **'Punta Banda'**
 - Collected from the Punta Banda Peninsula in Baja California
 - Plants produce hundreds of red meaty, thick skinned fruits despite heat, water stress and poor soil
 - Renowned for its early maturity



Drought Tolerant Cultivar Selection: Cucumbers

- **‘Beit Alpha Cucumber’**
 - Its middle eastern heritage makes this a heat tolerant plant
 - Beit Alpha is generally gynoeceious (producing mostly female flowers) which means it starts fruiting earlier and is very productive
 - Pick fruit when small, 6-8“



Water Harvesting

- Gray Water: Example: Place bucket in shower to catch water while it's heating
-Viable option for container gardens
- Rainwater: Depending on size of collection area, even small rain events can provide helpful quantities of irrigation water

Water-Wise Vegetable Gardens Summary

- Incorporate organic matter into the soil
- For deep rooted crops, deliver water slowly & directly to encourage deep roots
- Cover bare ground with mulch
- Eliminate weeds
- Modify the growing environment through wind breaks and shading

Water-Wise Vegetable Gardens Summary

- Consider drought tolerant vegetables
- Select efficient irrigation system
- Take advantage of gray water and rainwater harvesting when appropriate
- Pay attention to plants' current needs-don't under- or over-water
- Each garden is unique; consider your situation & plan accordingly

Thank You

- Questions?

