Seed to Crop: Improved Practices

Part 1 of improved vegetable production training program

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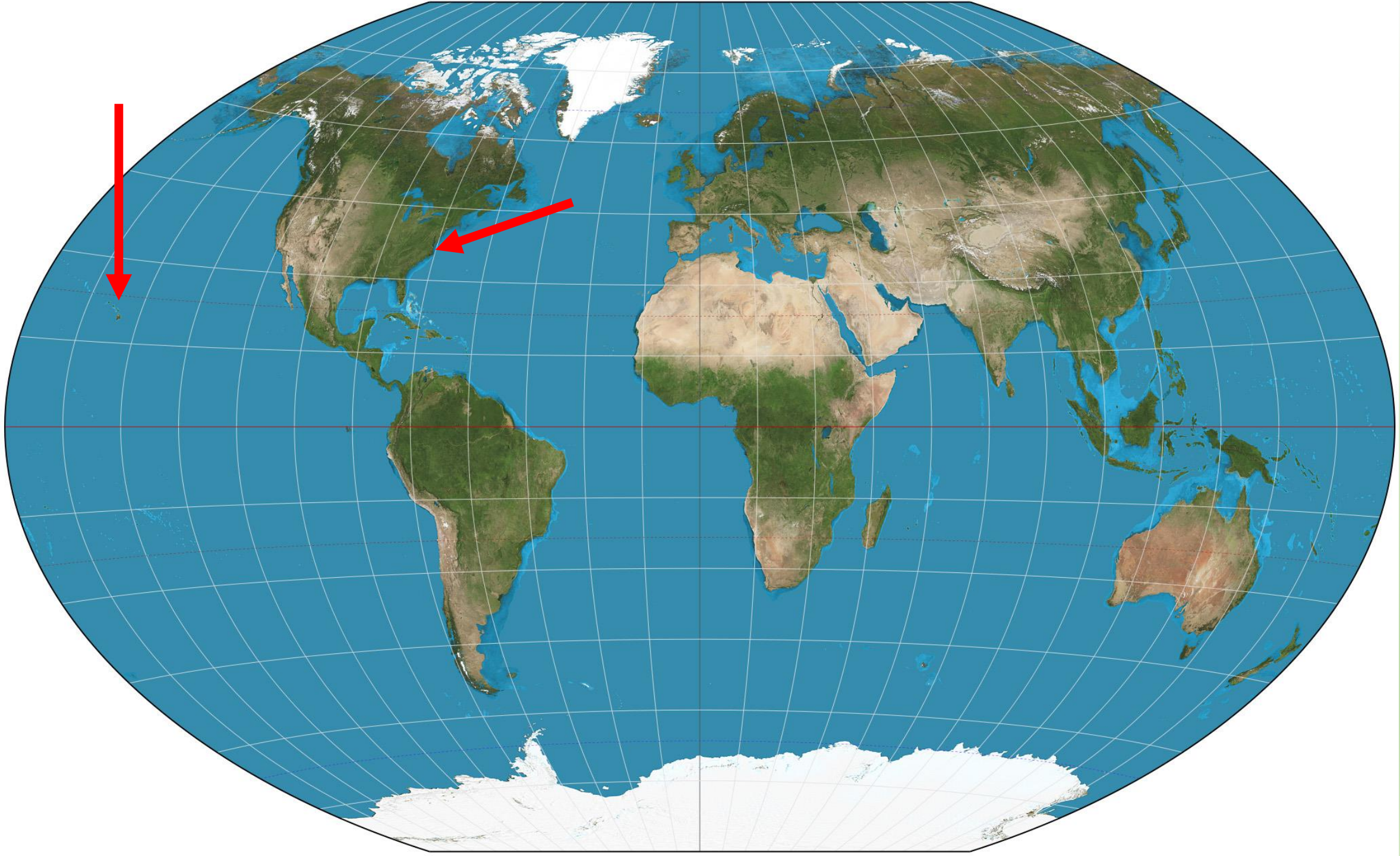
Objectives

Discuss possible management practices to improve seedling production

- Nursery establishment
- Nursery management
- Seed acquisition
- Seed sowing
- Seedling management
- Transplanting
- Weed Management
- Irrigation Management



- University of Hawaii Master’s Student
- Focus on soil amendments, plant growth, and conservation agriculture
- Horticulture undergraduate degree

About you

- What are your careers?
- What crops do you grow?
- What are your farming practices?
- What do you want to take away from this discussion?
- What can I learn from you?

Importance and Overview of vegetable production

- **Nutrition**
  - Vitamin A, Iron, Zinc
  - Micronutrients

Importance and Overview of vegetable production

- Economics
  - Higher market prices
  - Good supply/demand
  - Wider market

Importance and Overview of vegetable production

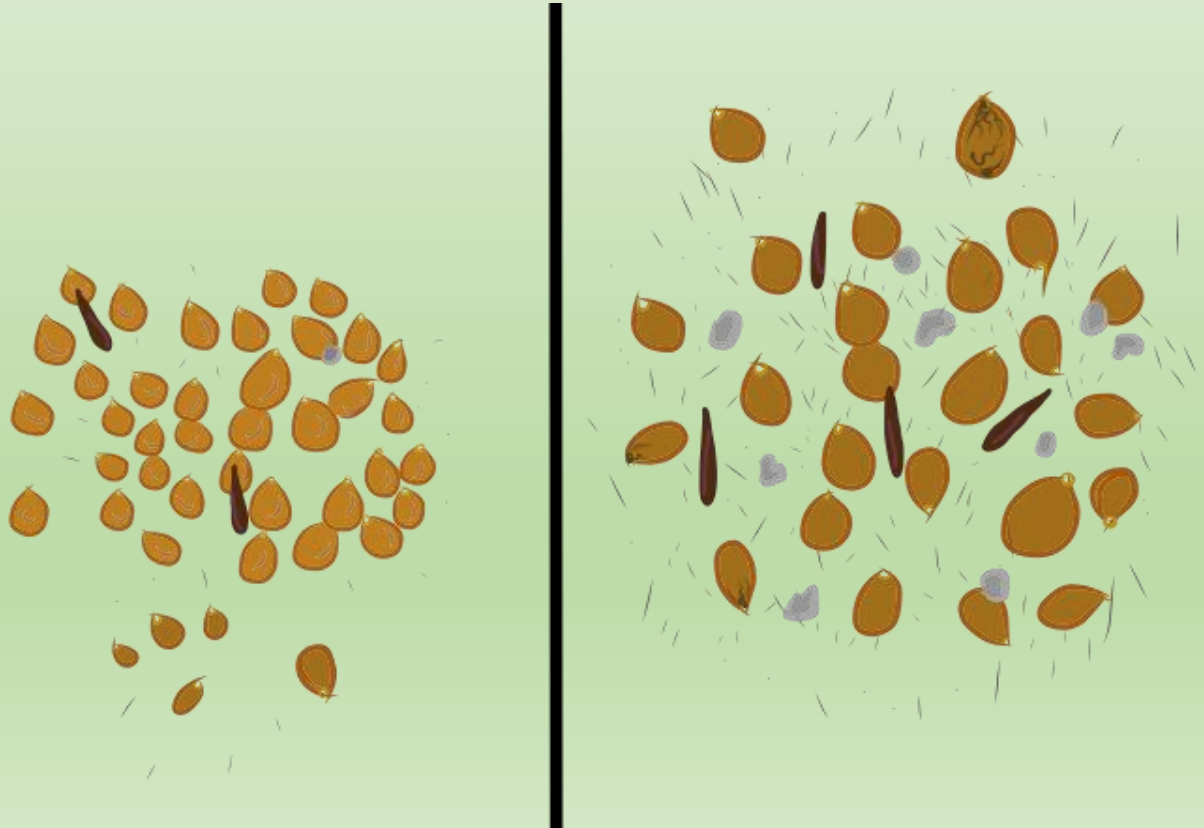
- Vegetables grow faster than most grain crops and can produce more income faster

Seed Acquisition

- Starting with the right seed is very important
- Better germination
- More vigorous plants
- More production
- Uniform crop

Certified Seed is Best!

- Certified seed guarantees a crop is what it says it is
- Guarantees a certain germination rate



Save your receipt and keep records!

- Always ask for a receipt with the itemized list of seeds that you buy
- Keep a record of seed buying
- If seeds are not the right variety or do not germinate well you can use your records and a receipt to get your money back.

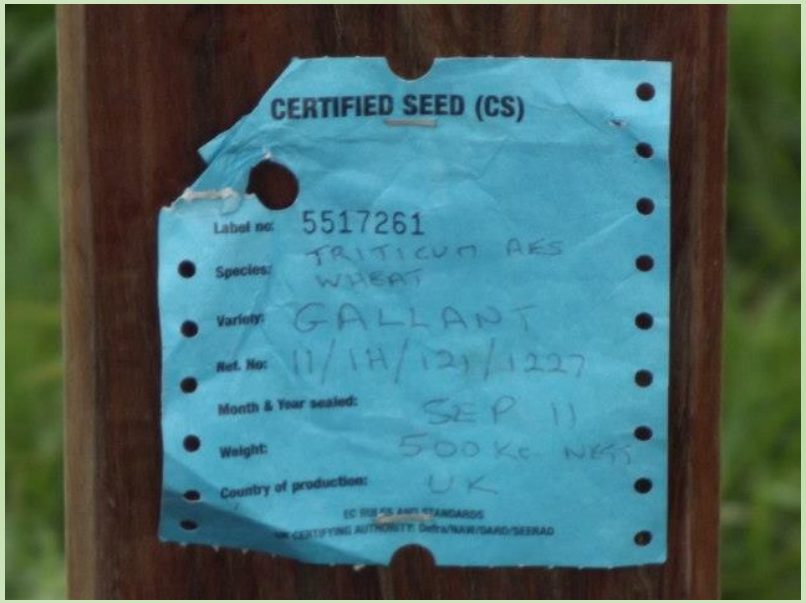


Photo credit, Colin Smith

Discussion

- What are your hesitations to growing vegetables?
- Where do you normally get seed from?
- What issues do you face with seed acquisition?
- Do you have anything to share with me?

Nursery Establishment and Management

Photo credit J.B. Friday

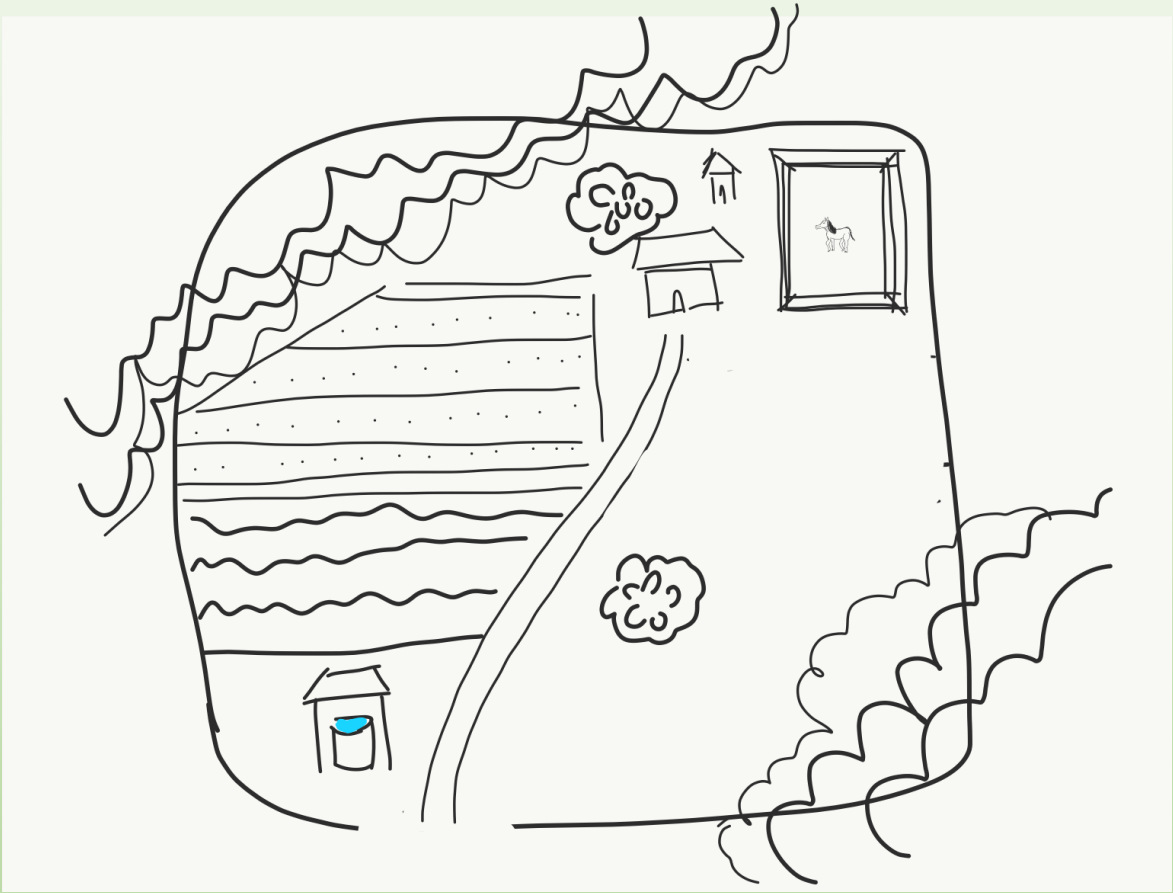
Assess farm resources

- Proper assessment of resources
- Plan, organize, and monitor nursery

1. Determine resources through a mapping process
2. Evaluate present status, goal, and determine steps to reach goal

Mapping

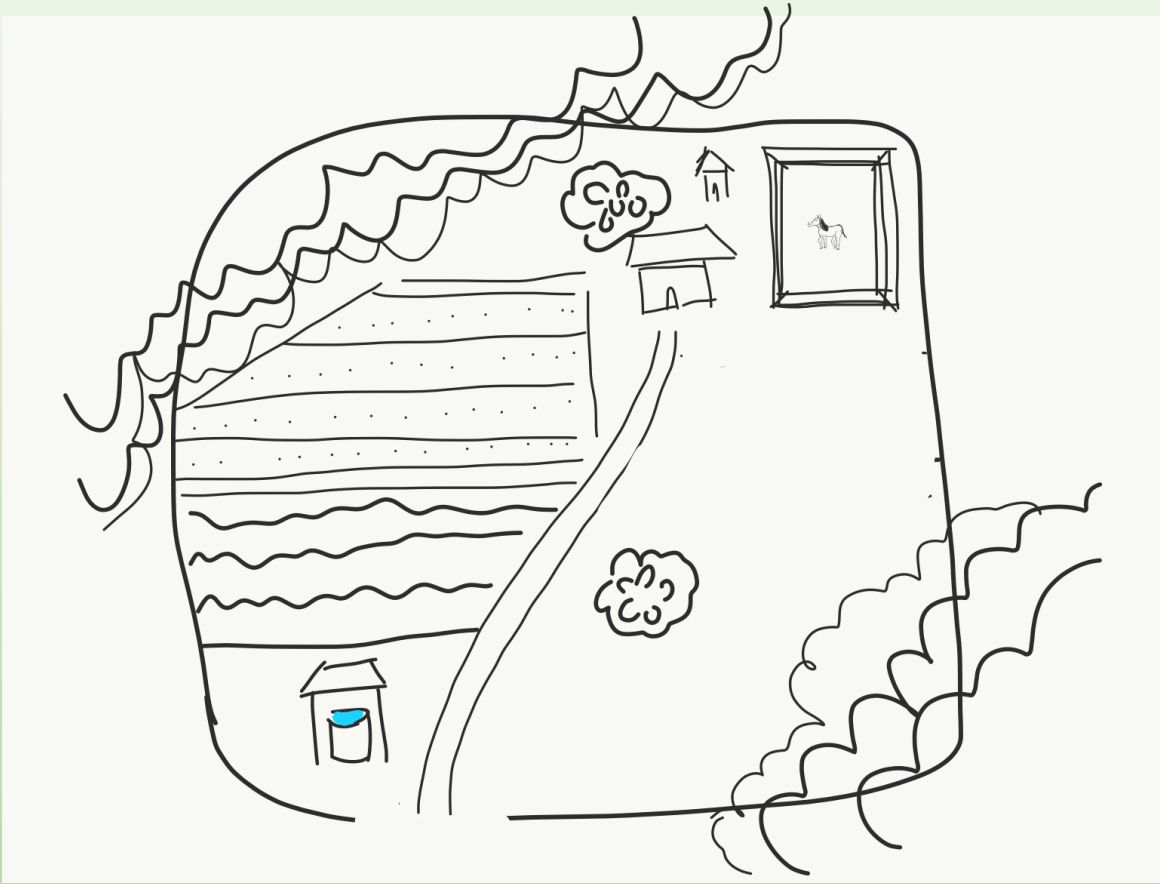
- All crop fields
- All structures
- Livestock
- Water access
- Roads and paths
- Landscape features



Evaluation

- Does your land have the space?
- The right environment?

- Exposure to all day sun
- Close to water source
- Protected from animals
- Protected from elements
- Not close to crop fields



Nursery Planning exercise

- Number of seedlings needed
- Spacing for seedling density
- Trays or seedbeds?
- Crop rotation?

Example

- I want to grow 100 tomato, 100 eggplant, 100 nightshade
- I want to grow in seedbeds
- My seedlings need 10 cm spacing in rows 20 cm apart

So….

10 cm x 20 cm x 300 seedlings

= 60,000 square centimeters or 6 square meters

I would only need a small area to grow many seedlings.

Consider extra beds for crop rotation!

Types of seedling nurseries

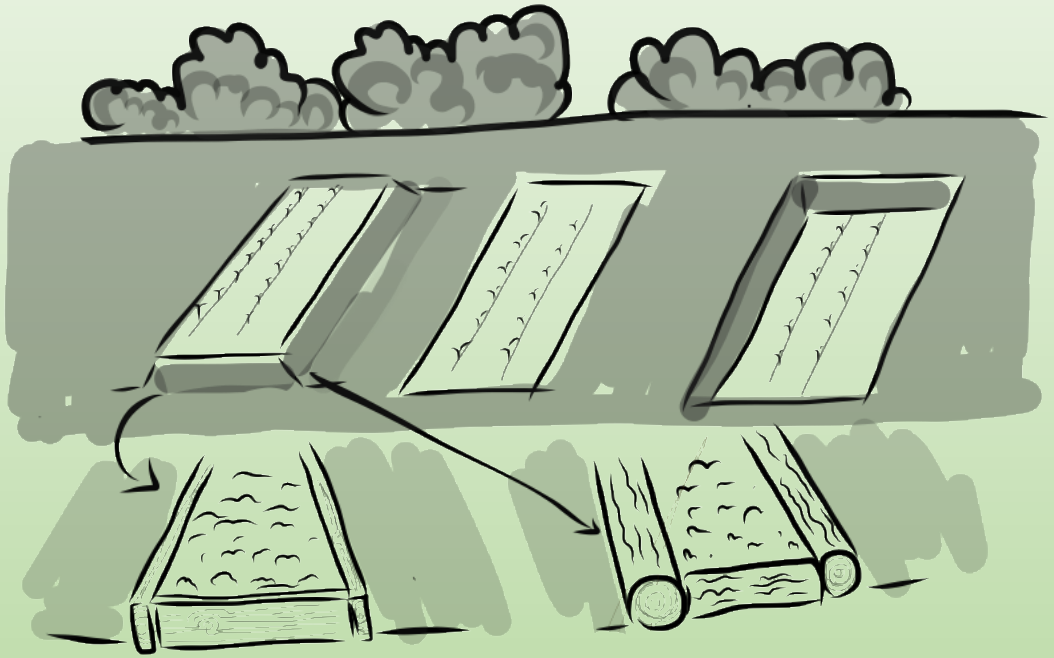
- Seedbeds
- Trays


Photo credit- Roshan Paudel


Photo credit-treesforthefuture.org

Photo credit-Charles Dowding

Photo credit-JB Friday



Protecting Seedlings

- Animals
- Too much sun
- Heavy rain or other weather
- Strong wind

Windbreak


Photo credit-CTAHR

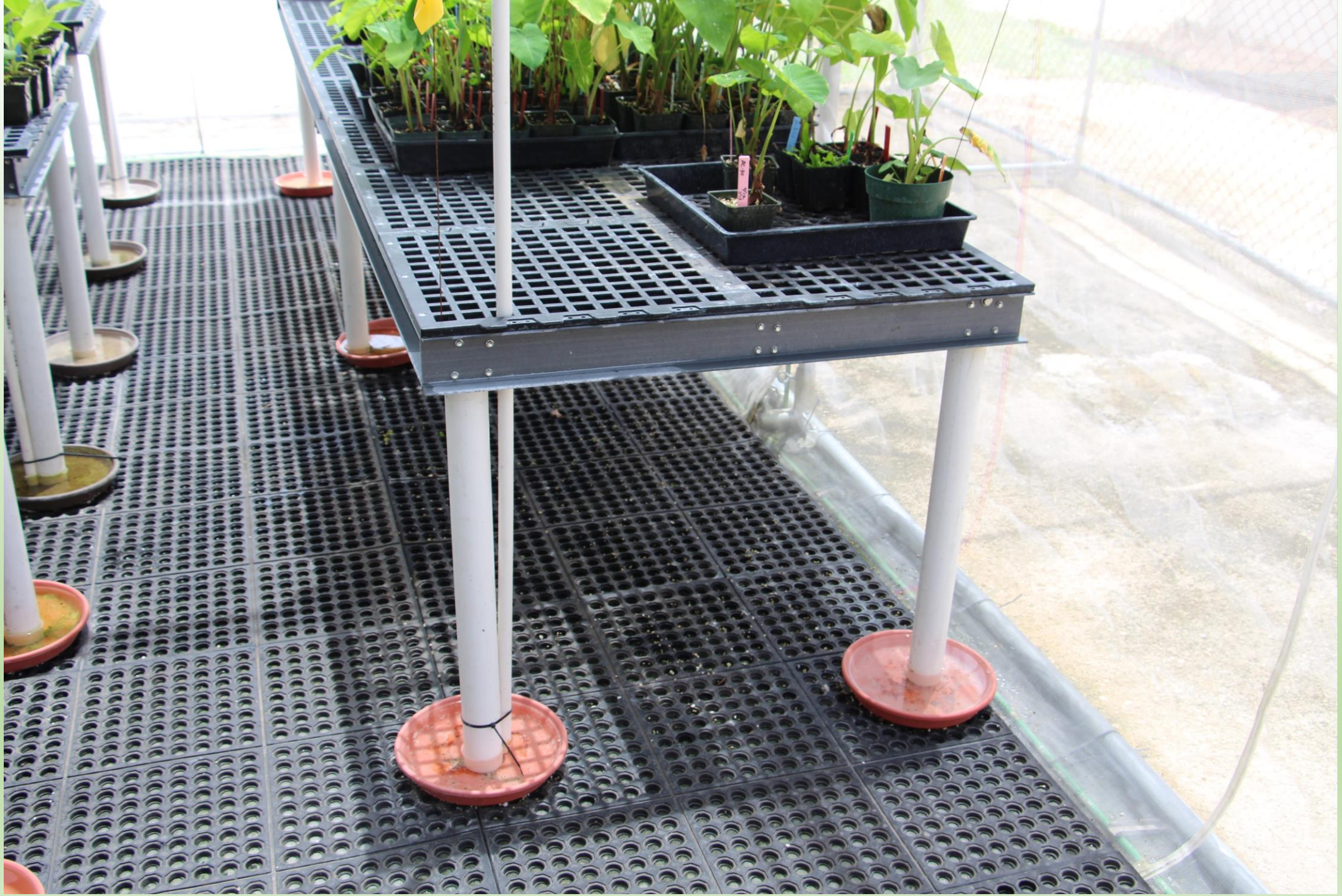

Photo credit- Erwin Cole NRCS

Shade structures

Photos credit- J.B. Friday

Fences, tables

Photo credit- NPS



Water management

- Trays need more watering, seedbeds can sometimes survive on rain only
- Hand watering or drip irrigation would be best

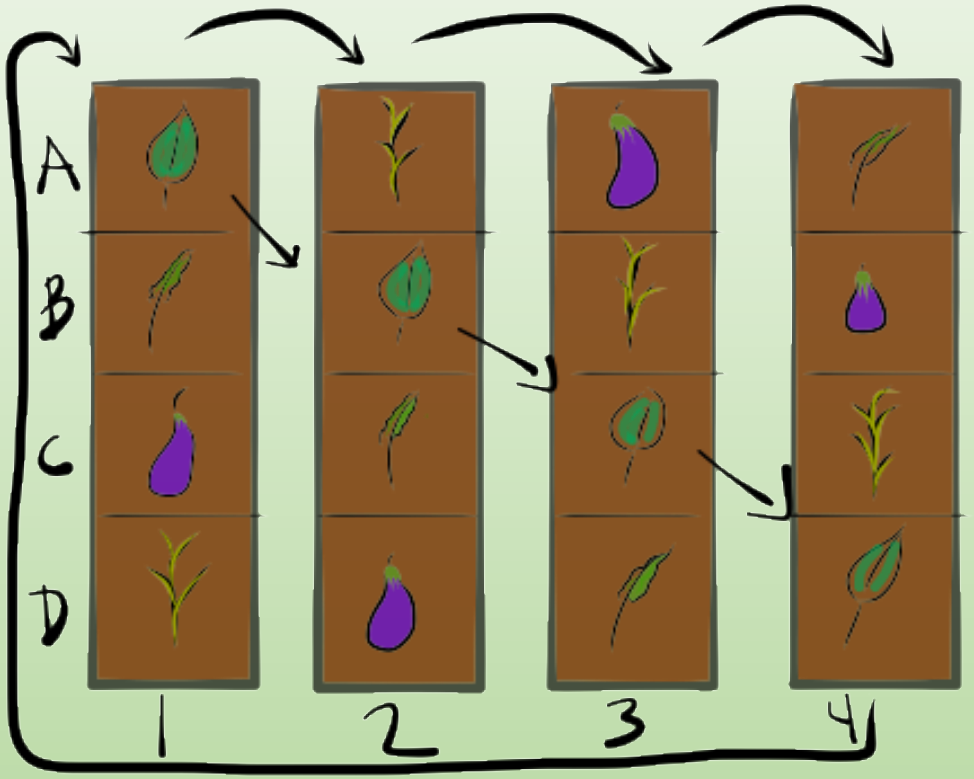
Fertilizer management

- Seedlings need less fertilizer than large plants
- About 20 liter of compost in seed beds
- Supplement with NPK fertilizer if leaves turn pale yellow

Crop rotation

- Disease control
- Soil health
- Based on plant family
- Tomato, Nightshade,

  Eggplant all in the same family



Keeping records

Seedbed	O-Organic T-Transitional C-Conventional	Size	Crops	Sowing Date	Inputs Input Date of Use - Rate of Use			Expected Yield	Actual yield
1	O	1mx5m	Tomato seedling	10/21	Cow manure Lime	10/17	5 lb	150 seedlings	129 seedlings
					Mulch				
2	O	1mx5m	Fallow					None	
3	C	1mx5m	Rice seedling	10/21	Potassium nitrate	11/03	14kg/100L Every week	500 seedlings	512 seedlings
4	O	1mx5m	Onion seedling		Cow manure	1/15	5 lb	150 seedlings	100 seedlings

Discussion

- What seedling nursery is preferable?
- What are issues related to seedling protection in your farms?
- Are you using or would you consider crop rotation?
- Did you learn anything new and do you have anything to share with me?

Seed Sowing- Using a schedule

- Use time to harvest information

	Nightshade	Eggplant	Tomato
Days to Transplant	28-44	28-44	28-44
Days to Harvest	40-60	60-90	60-80
Total Days	68-104	88-134	88-124

The schedule

Month	January	Feb	March	April	May	June	July	August	Sept	October	Nov	Dec
Tomato	Sow crop 1	Transplant crop 1		Sow crop 2	Harvest crop 1 transplant crop 2	Harvest crop 1	Harvest crop 1 Sow crop 3	Harvest crop 2 Transplant crop 3	Harvest crop 2	Harvest crop 2 Sow crop 1 for next year	Harvest crop 3 Transplant crop 1 for next year	Harvest crop 3
Eggplant		Sow Crop 1	Transplant crop 1			Harvest crop 1	Harvest crop 1	Harvest crop 1 Sow crop 2	Harvest crop 1 Transplant crop 2	Harvest crop 1	Harvest crop 1	Harvest crop 2
Cover crop	Direct seed cover crop	Cover crop	Cover crop	Cover crop	Cover crop	Cover crop	Cover crop	Cover crop	Cover crop	Cover crop	Cover crop	Cut down cover crop and lay for mulch

Germination test

1. Use a moist cloth
2. Place seeds in cloth
3. Keep cloth moist
4. Check at 7 days for germination and every day after up to 21 days

- Count number of seedlings germinated
- Calculate your germination percentage

Number of seeds germinated/number of seeds sown then x 100

Will give you germination percentage

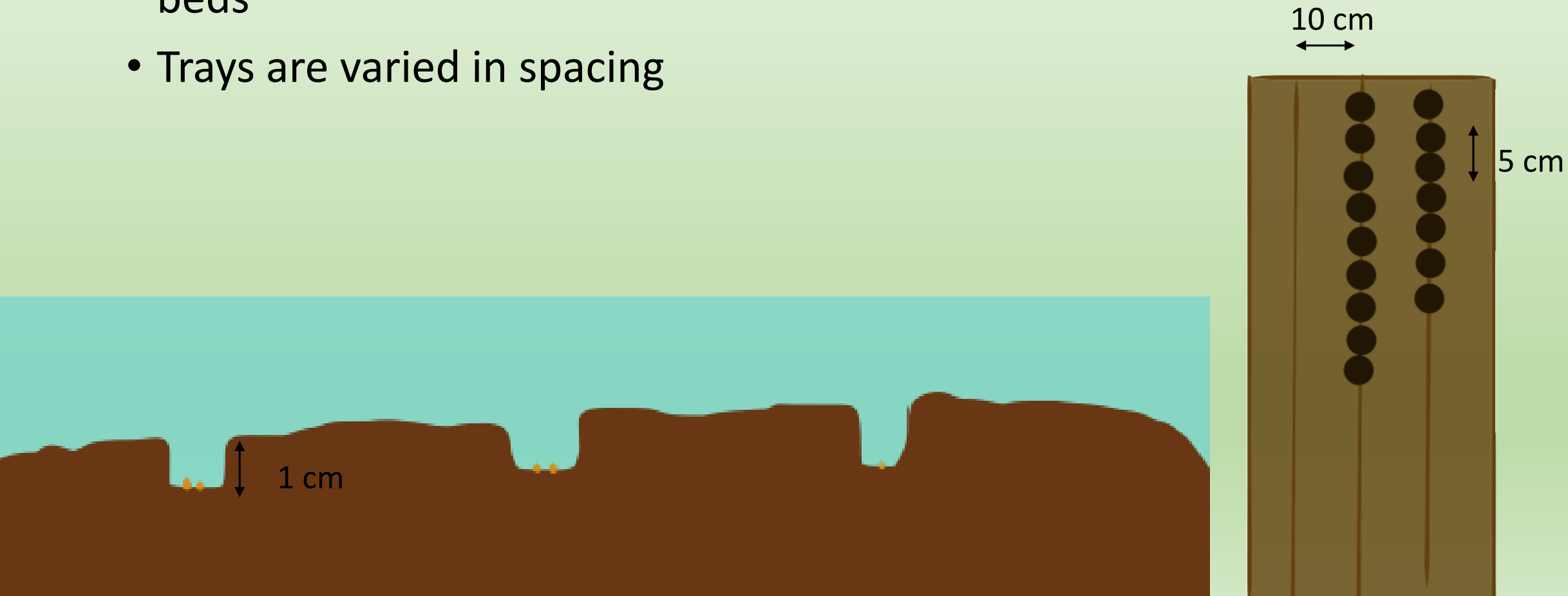
20 seeds used, 17 germinated

17/20 = .85 x 100 = 85%

- Germination is 85%
- I need to know how many extra seedlings to sow to make up for my 85% germination percentage
- Divide the number of seeds needed by the germination percentage
- I want to have 150 seedlings
- 150/.85 = 176.4 or 177 seeds
- I need to sow 177 seeds to ensure I will have 150 seeds germinate

Seed Sowing

- 1 cm depth, 5 cm spacing, 10 cm between rows if planting in seed beds
- Trays are varied in spacing



Common Problems- Damping off

- Discolored lesion

- Sterilize
- Do not overwater
- Use fungicides

Photo credit to Howard F. Schwartz

Stunted Seedlings

- Seedlings are short or leaves are small, discoloration

- Usually nutrient deficiency
- Chemical or salt damage
- Fertilize or run clean water through

Photo credit- University of Minnesota

Wilted Seedlings

- Leaves and plants weeping over, look dry

- May be too little or too much water
- Or root damage
- Determine irrigation issues
- Check roots for rotting


Photos credit- Debbie Roos

Burned leaves

- Leaves are brown and dead in spots

- Too much sun
- Or chemical burn
- Keep in 30% shade
- Do not get fertilizers on plant tissue

Photo credit-Fenrisulfir

Leaf Miner

- Very small insect that causes small lines in leaves and dead leaves
- Spray 4% neem seed extract on plants

Photo credit-Scot Nelson

Virus Free Seedling Production

- Cover the seed bed with insect netting
- Remove infected plants
- Sterilize seed beds

Photo Credit- Scot Nelson

Soil Sterilization

- By heat and sun or chemicals
- Wet seed bed or soil
- Cover with black plastic, seal edges with soil
- Let sit for 3-4 weeks in full sun
- 2 days after removing plastic you can use the beds


Photo credit to Rahul143

Weed Control

- Weeds will quickly take over seed beds and kill seeds
- By hand pulling or very gentle hoeing
- Roots of seedlings are very fragile

Picture credit- CTHAR News

Discussion

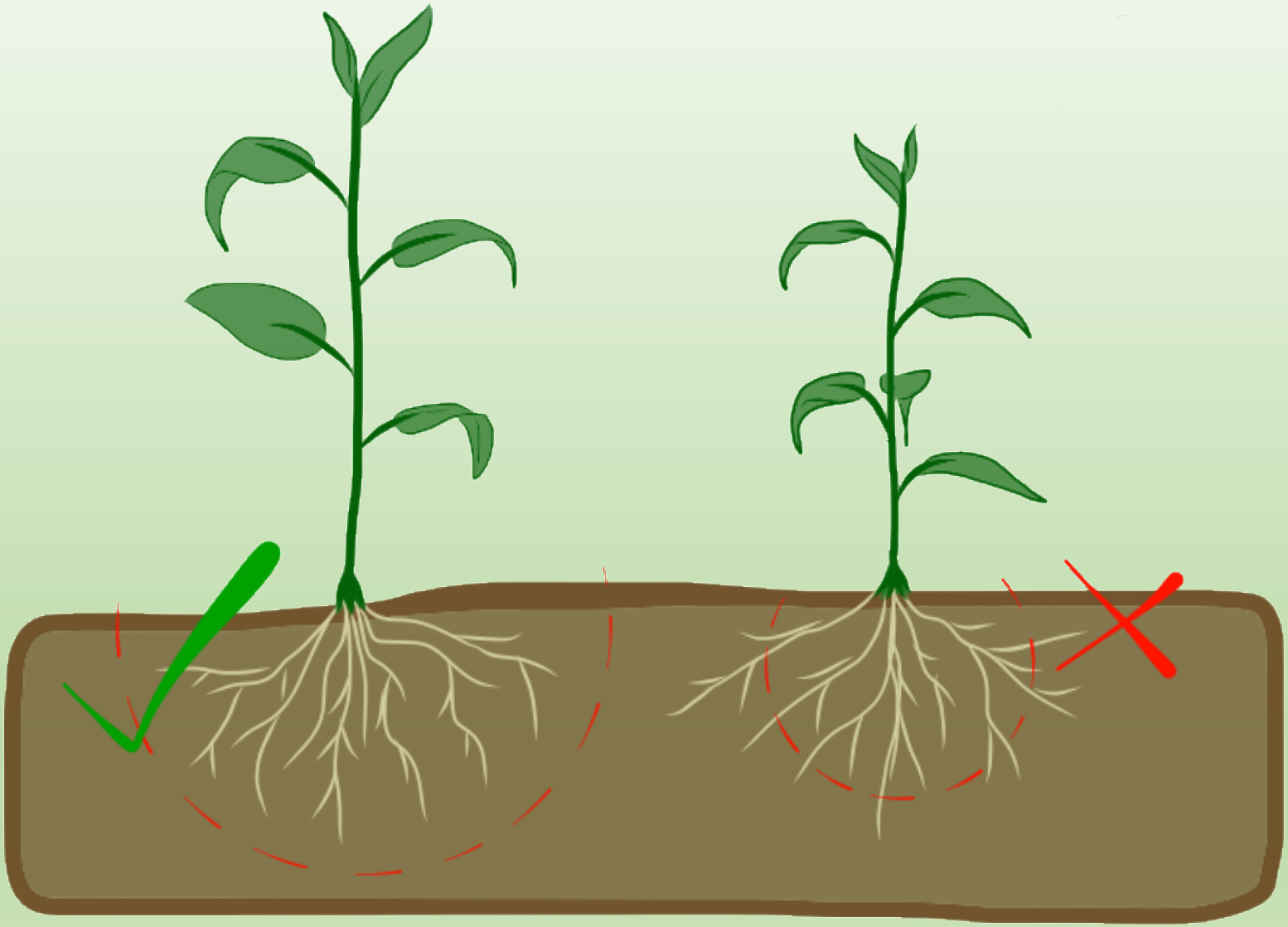
- What other seedling problems did I miss?
- Do you, or will you do germination tests?
- Do you, or will you use germination schedules?
- Did you learn anything new from this?
- Do you have anything to share with me?

Transplanting Seedlings

- Timing is very important
- For tomatoes, eggplants and nightshade 4-7 true leaves and 10-15 cm tall is the perfect size to transplant.
- Field should be prepared by destroying weeds or tilling field. Cover crops should be cut back.
- Disturbing soil will cause more weed germination
- Ensure soil is moist before transplanting.
- Transplanting should occur before or after noon to avoid heat

Hardening off

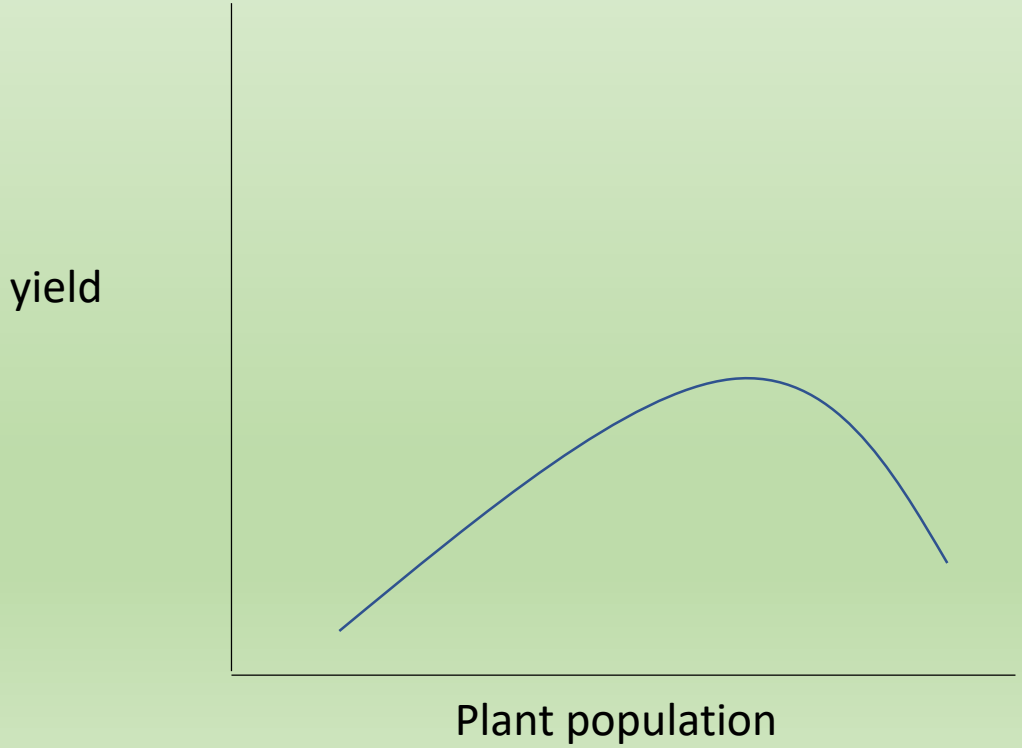
- Seedlings should be prepared to transplant by hardening off. This involves reducing water supply and removing shade structures around 2 weeks before transplanting.

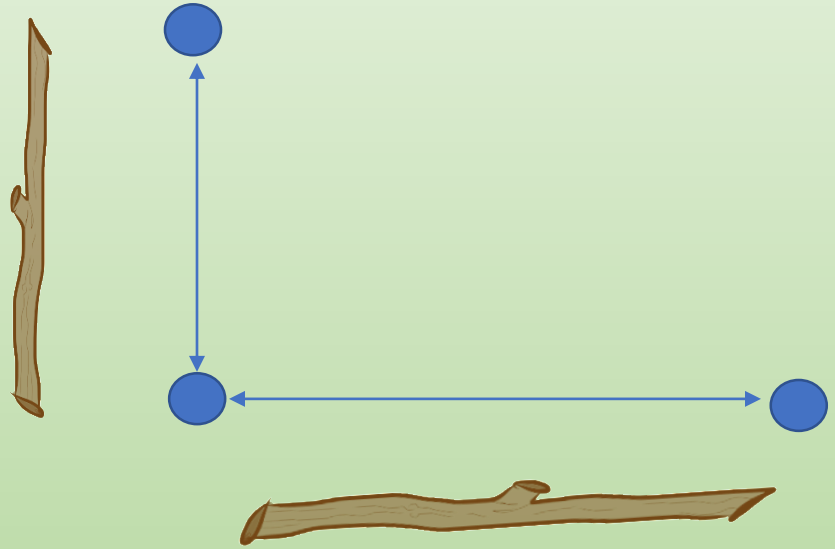


- Spacing

Tomato	Eggplant	Nightshade
35 x 100 cm	30-75 x 30-75 cm	30 x 100

- Large root balls intact
- Immediately water after



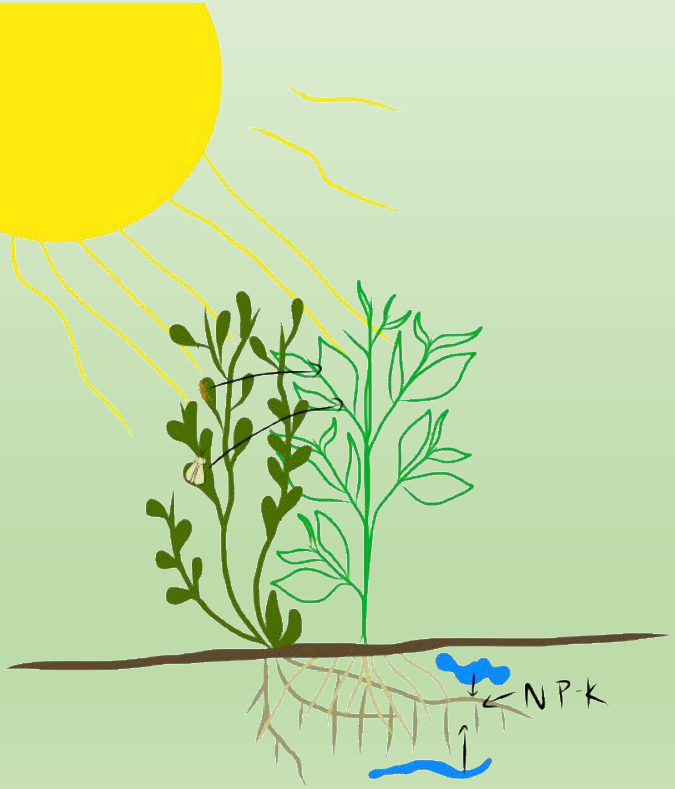


Discussion

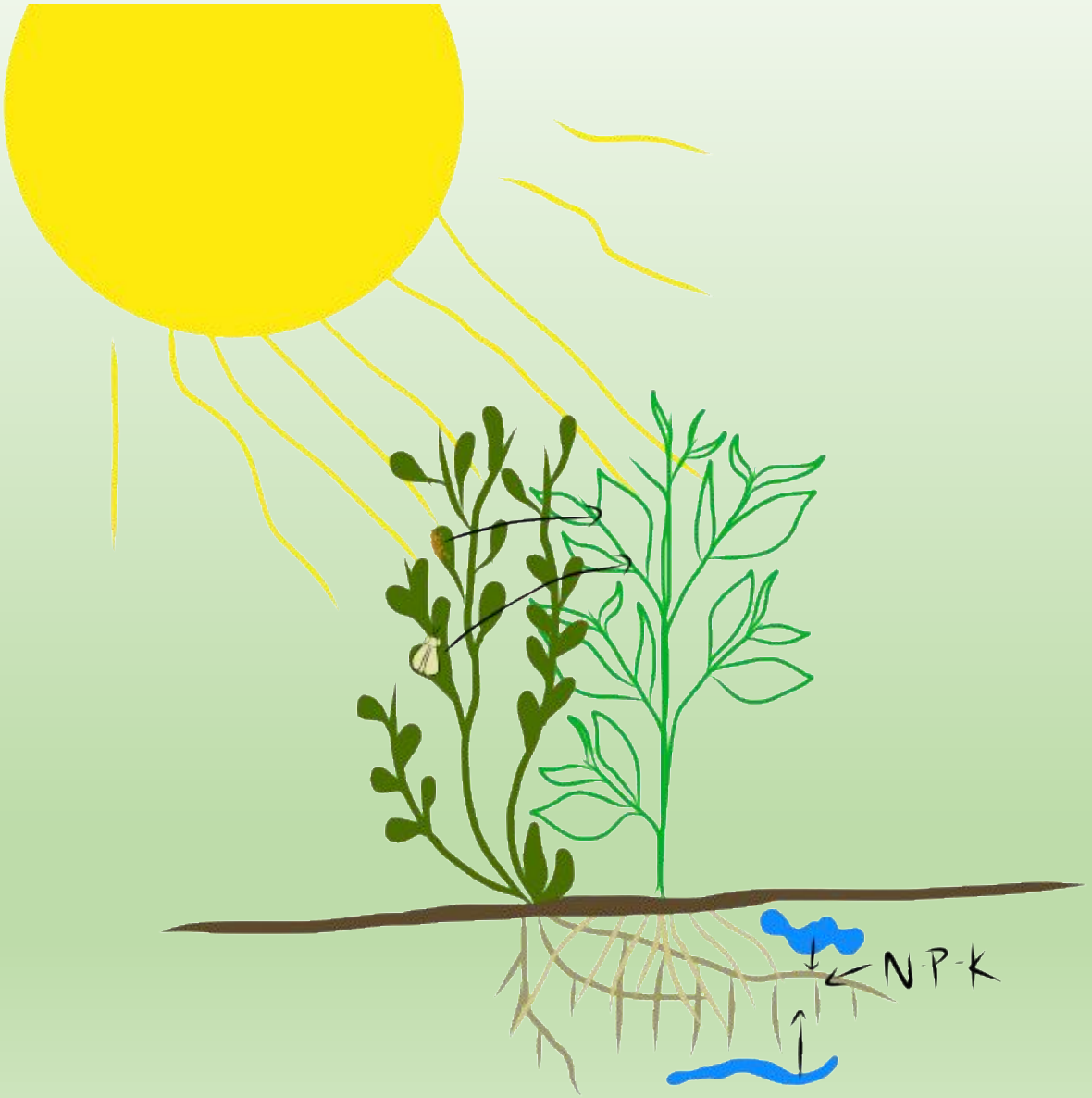
- What is your success rate with transplanting?
- Did you learn anything new from this?
- Do you have anything to share with me?

Weed Management

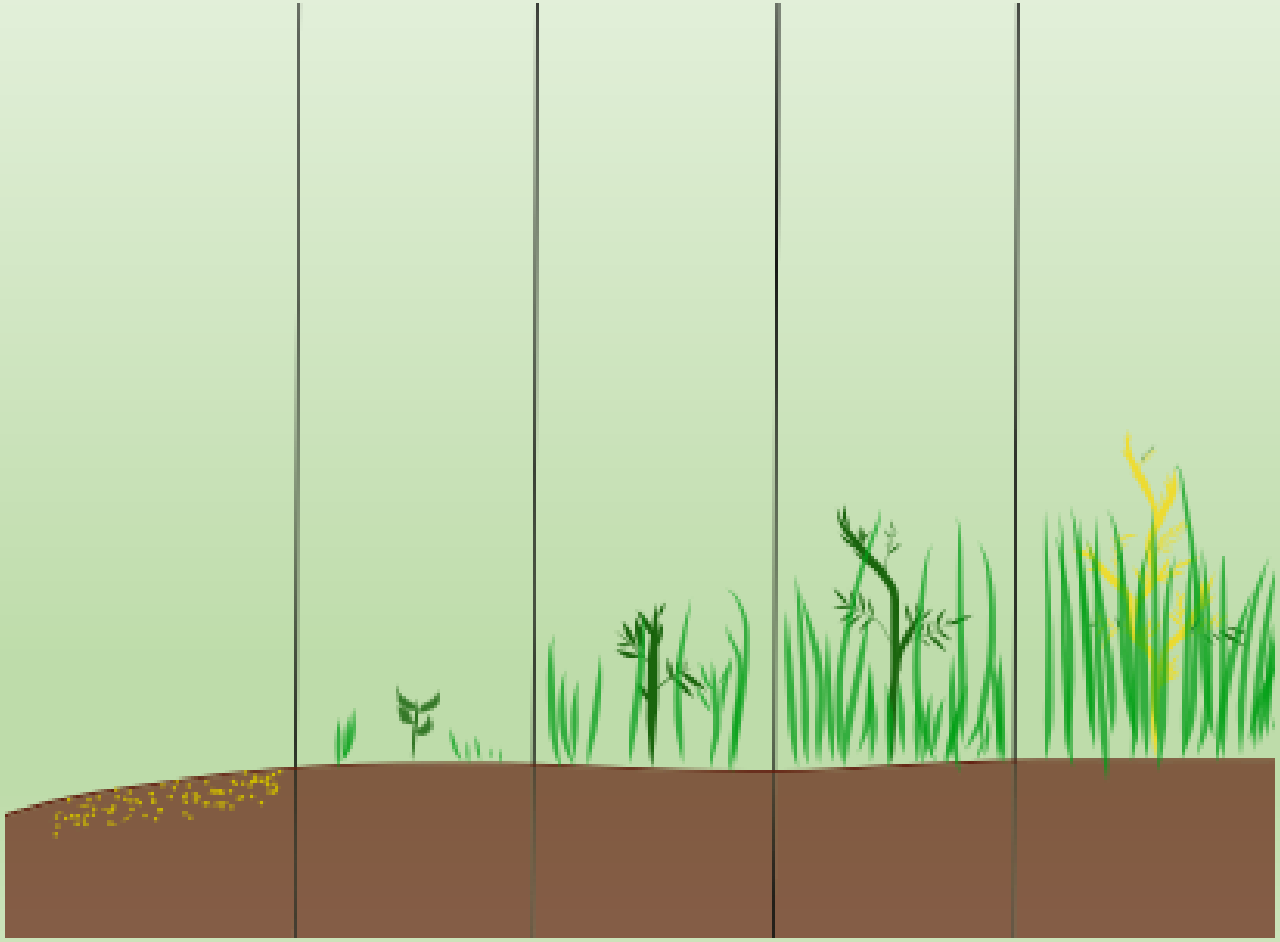
- Weeds compete for light, water, and nutrients



- Weeds also harbor pests and diseases



- Weeds seeds last very long in the soil in very large numbers
- Weeds germinate and grow faster than vegetable crops usually



Weed Classification

Annual	Perennial	Biennial
• Fast growing • Make seeds quickly • Short lifespan	• Lives multiple years • Slower growing • More difficult to destroy	• Lives two years • First year is growth, second year is reproducing

Broadleaves	Grasses
• All weeds that aren't grasses • Can grow from many points • Easier to pull or destroy, can be hoed or mowed	• All grass weeds • Grow from the base of the plant • Are more difficult to pull once large and can survive hoeing easier

Weed Control

- Hand pulling
- Hand cultivating
- Machine cultivating
- Cover crops
- Chemical control

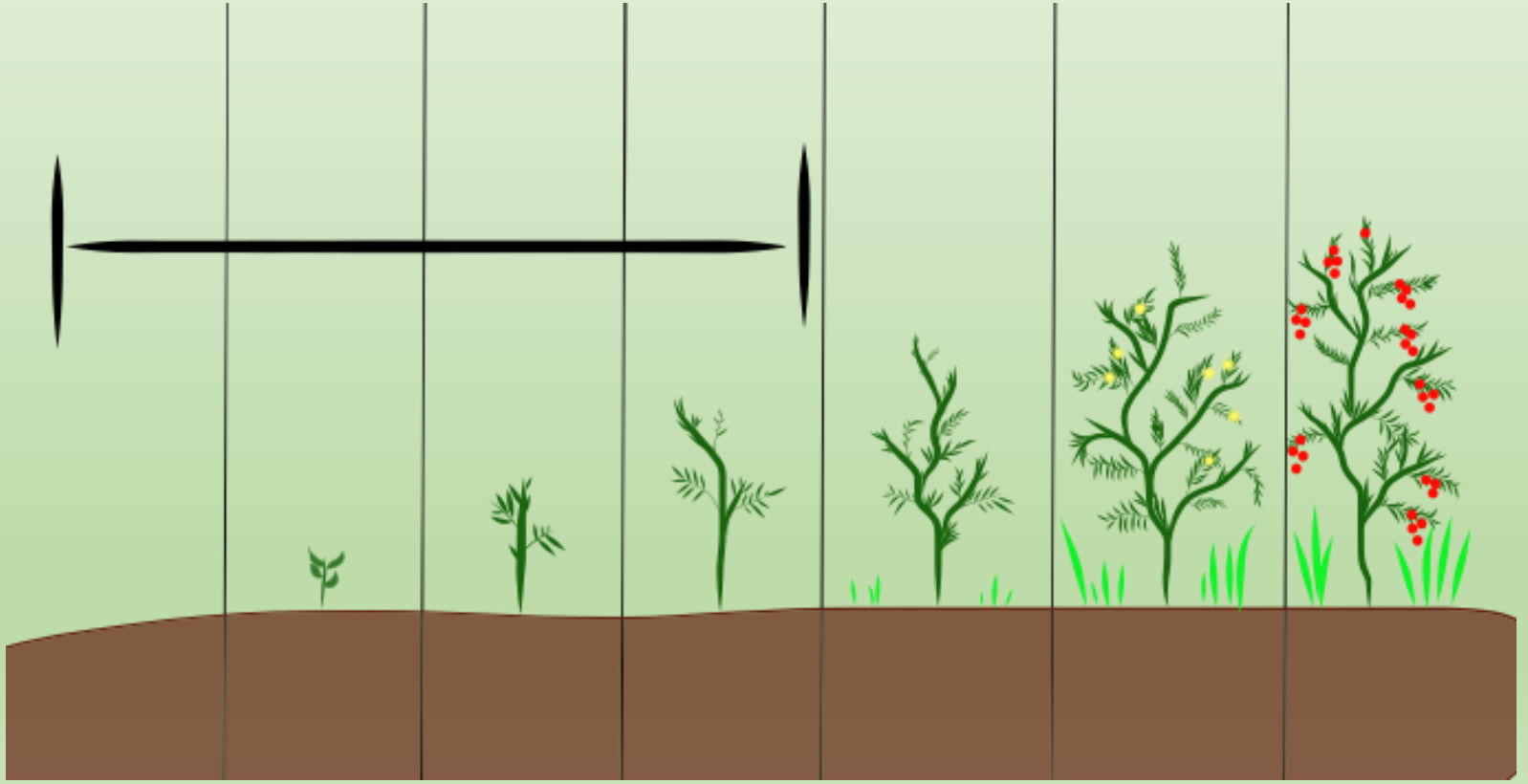
Photo credit - Depp trivia
https://commons.wikimedia.org/wiki/File:Weeding.jpg

Photo credit- Bosaideu
https://commons.wikimedia.org/wiki/File:For_weeding_choose_Glyphosate.jpg

Timing of Weeding

- Weeding takes many labor and time
- Focus on weeding at critical times

- Before planting the crop
- During the first 4 to 8 weeks
- Controlling weeds before they seed

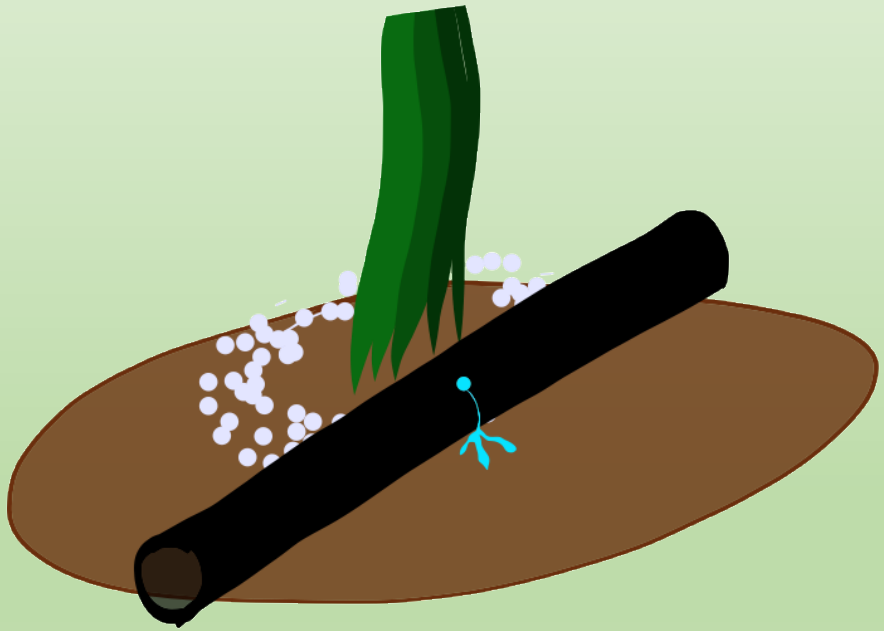


- Cover crops as weed control
- Can compete with weeds during fallow period
- Can be used as mulch to keep weeds down during crop growth


Photo credit- CIMMYT


Photo credit- Roshan Paudel

- Irrigation and fertilizer use
- The more accurate you are with fertilizer and irrigation the less weeds
- Drip and spot irrigation and basal fertilizer are the best



Health and labor issues with weeding

- It takes hundreds of hours to weed one hectare
- Weeding is damaging to a persons back
- Reducing amount of time in stooping position improves quality of life

Photo credit- Ariana Rose Taylor-Stanley

Photo credit- Gardening Solutions Flickr page https://www.flickr.com/photos/gardeninginaminute/14396908120/in/photostream

- Use cultural methods to reduce weeding
- Use properly sized tools to bend over less
- Practice good posture when weeding
- Change labor division so all farm hands weed evenly
- Chemical use if weeds are out of control

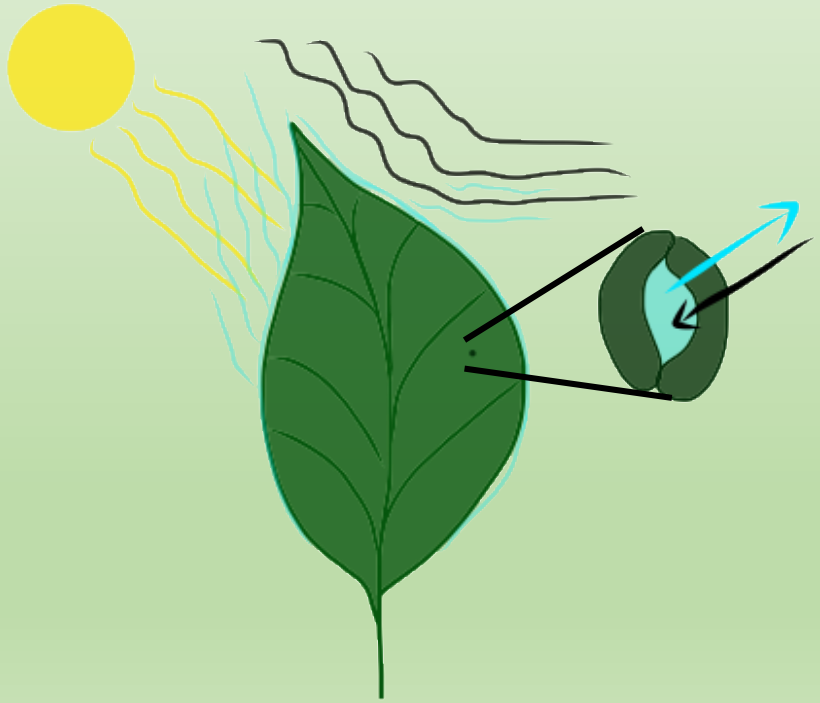
Photo credit: CIMMYT

Discussion

- How many hours do you spend weeding?
- What tools and techniques do you use?
- How do you think weeds affect your yield?
- Did you learn anything new from this section?
- Do you have anything to share with me?

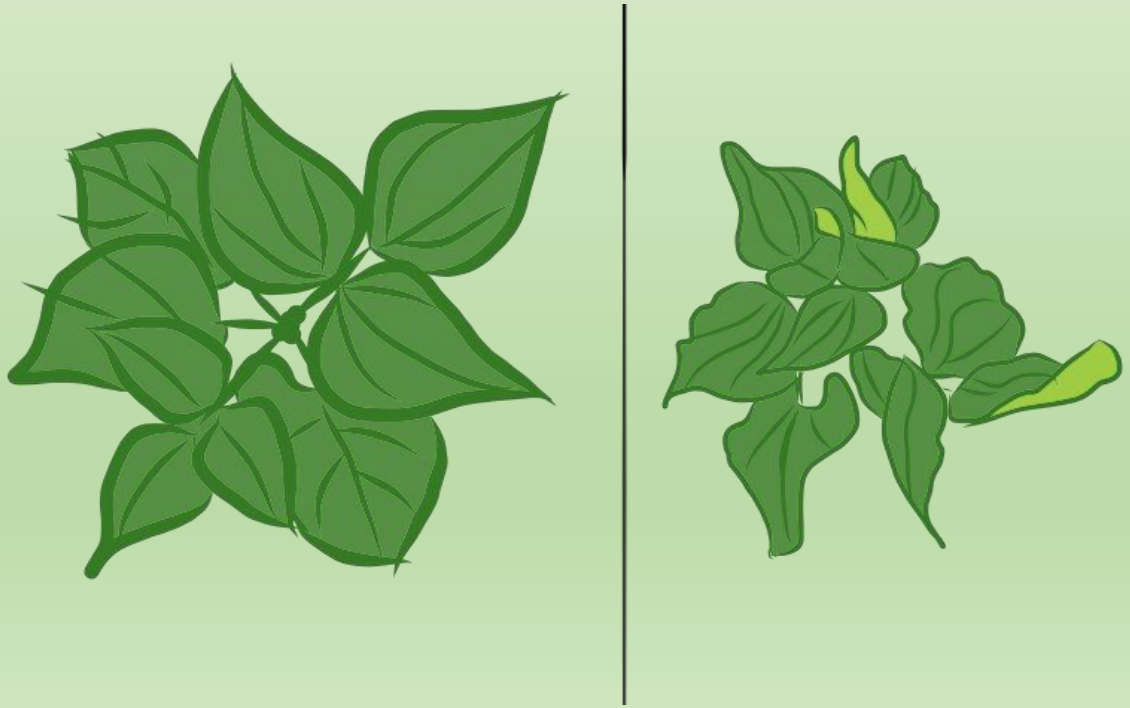
Irrigation Management

- Vegetable crops lose water very quickly
- Wind and sun exposure increase water loss



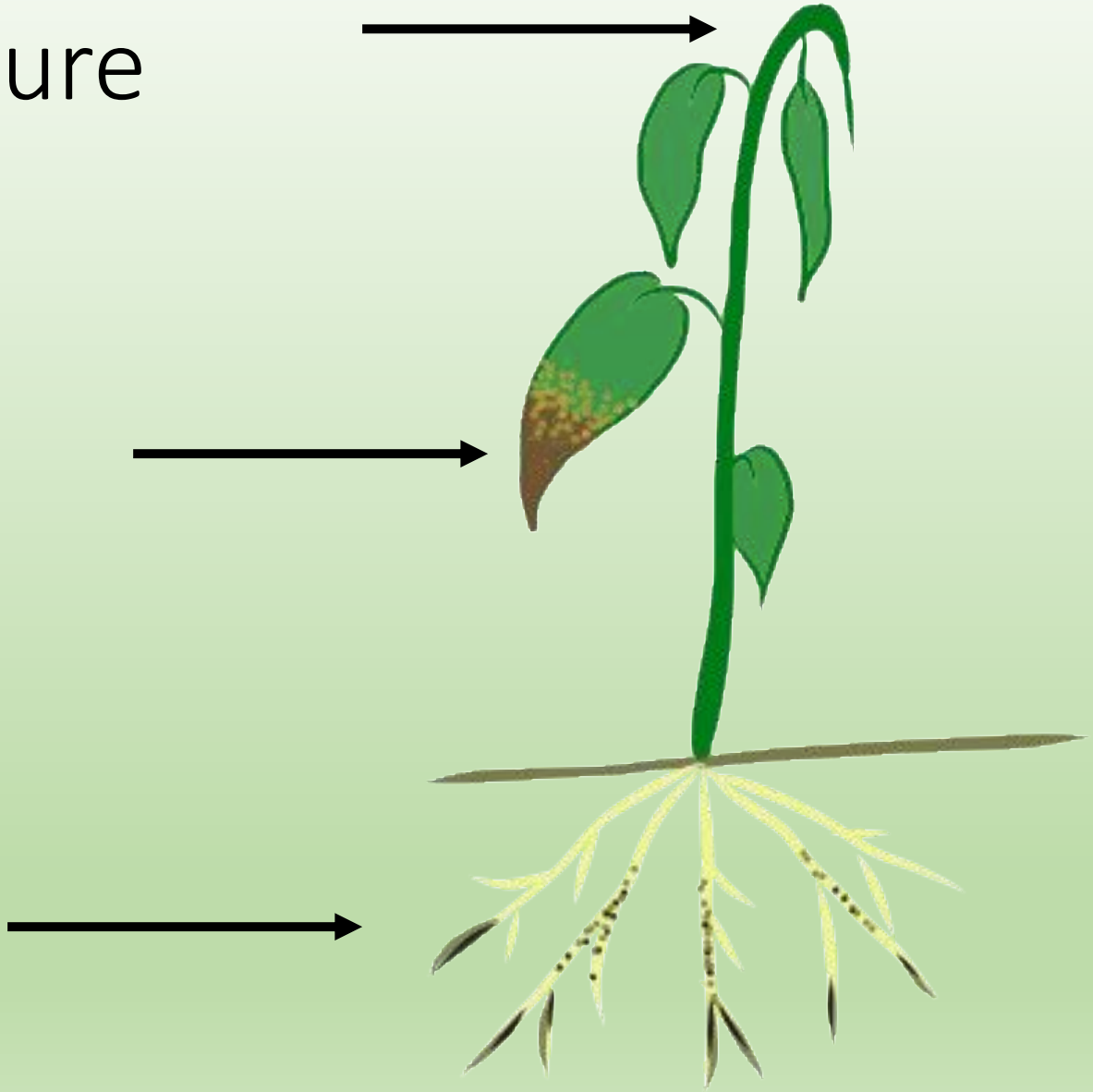
Drought Stress

- Can stunt plants
- Reduce yields
- Cause flowers and fruits to drop or be of poor quality



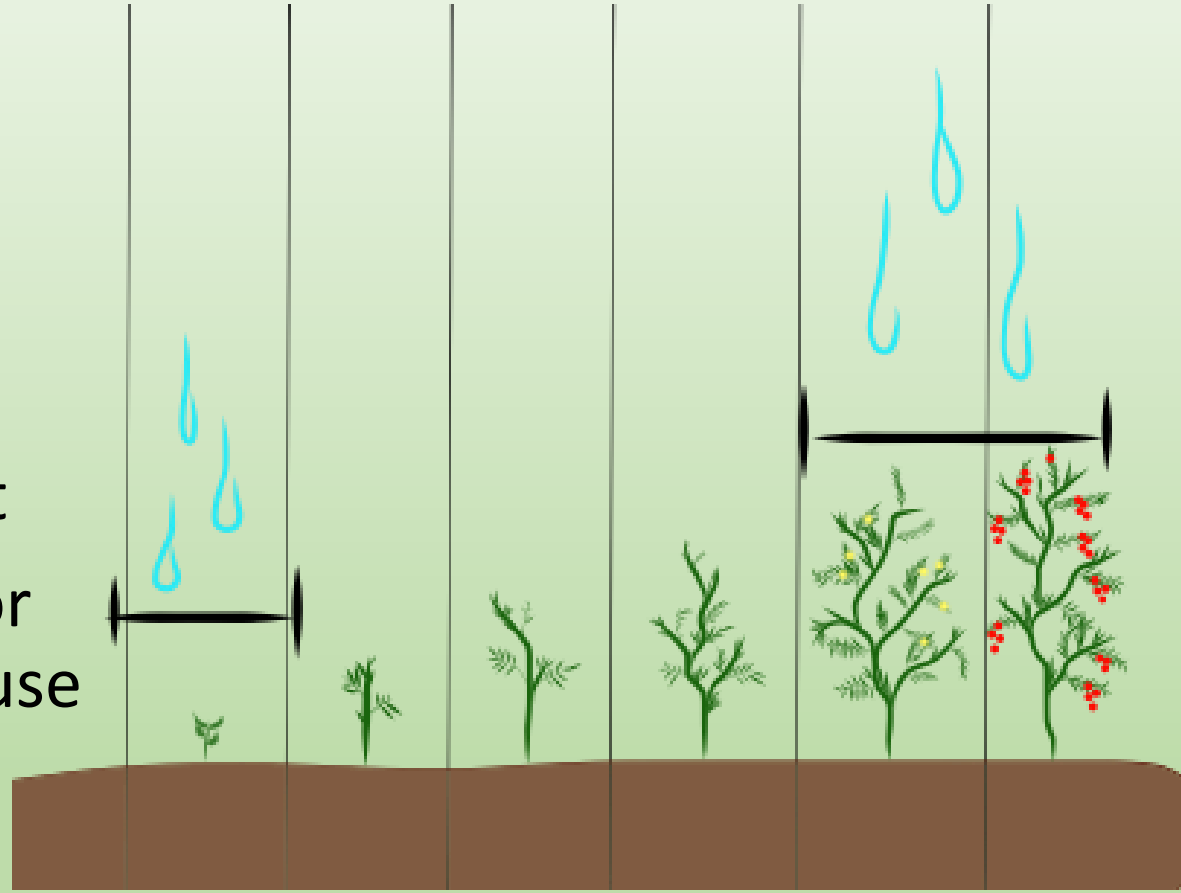
Too much moisture

- Can kill roots
- Cause disease
- Too much growth
- Reduce flavor
- Reduce yield



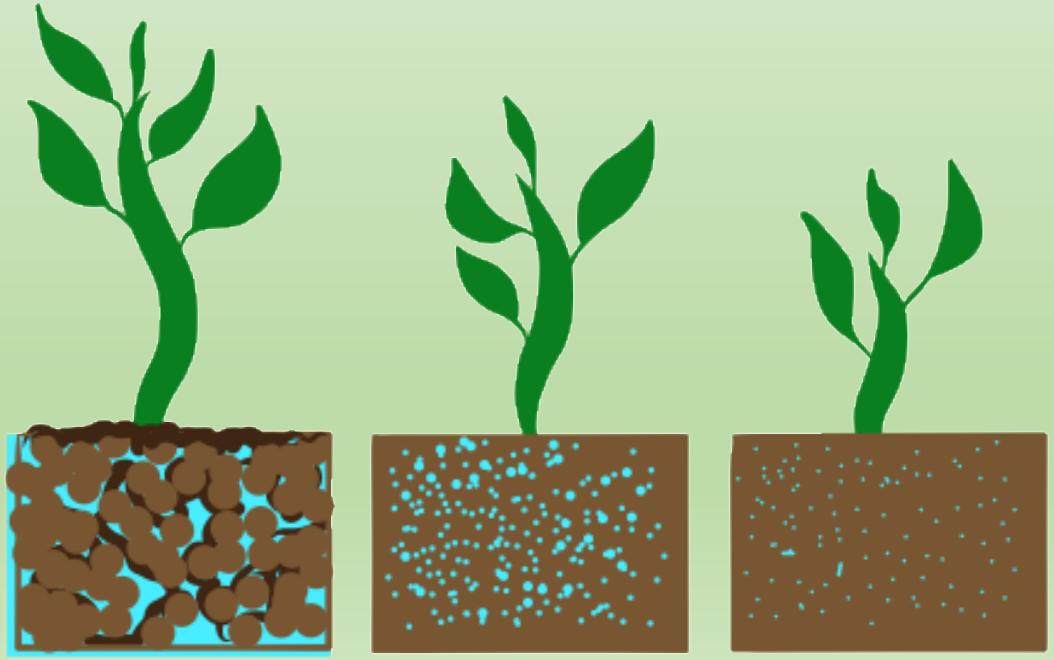
Critical periods of water use

- Specific periods that are important to manage water
- Seedlings
- Tomatoes and eggplants: Period of flowering, fruit set, fruit development
- Nightshade: Need water constantly for foliage harvesting, can reduce water use immediately after harvesting



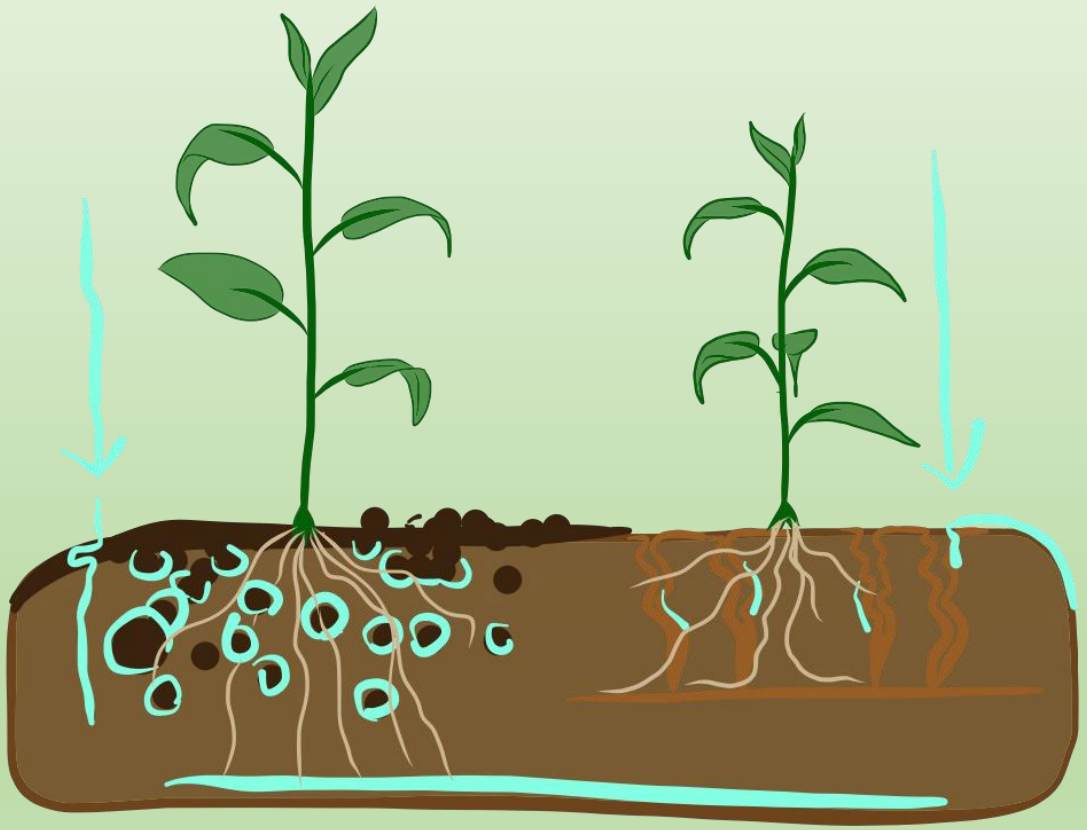
Soil water holding ability

- Important during low rainfall times
- Different soils have the ability to hold different amounts of water for different amounts of time



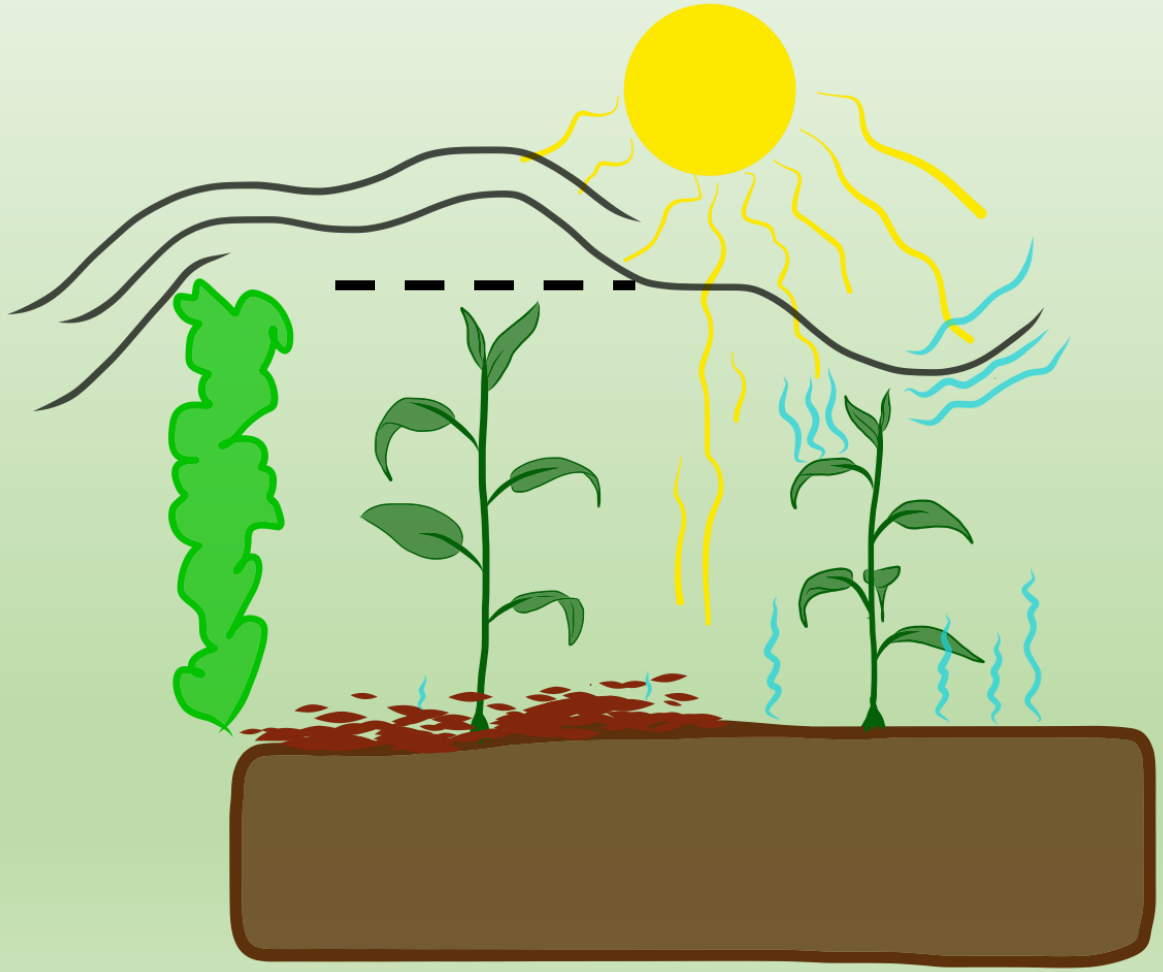
Increasing water holding ability

- Increase soil organic matter
- Reduce tilling
- Stop tilling



Reducing water loss

- Change soil bed type
- Shade structures
- Wind breaks
- Mulch



Irrigation types

- Surface: flooding or furrow
- Sprinkler
- Drip

Surface

- Flooding needs flat surface, furrow can have slope
- Furrows require labor
- Flooding can cause disease

Sprinkler

- Cheap and little labor
- Uniform
- Can cause disease

Drip

- Water efficient, good for weeds, low labor after install
- Potentially expensive

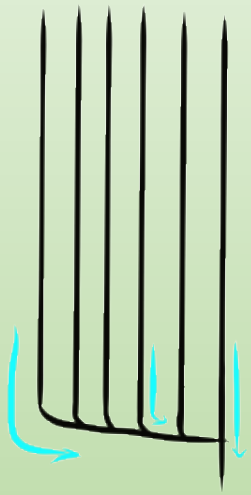
Water source

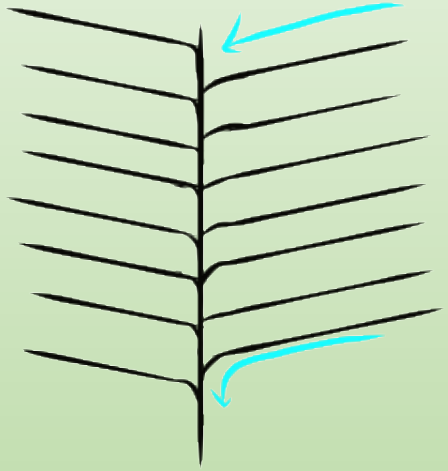
- No chemicals, salts, or sewage
- Know conditions of your water source

Photo credit- High Contrast

Drainage

- Can control water logging
- Open ditches are the only effective means
- Should run downhill
- Can use area where water collects to grow weed free water loving crops





Discussion

- What are your water sources?
- How do you irrigate?
- What issues do you have related to irrigation?
- Do you have access to irrigation supplies?
- Did you learn anything new today and do you have anything to share with me?

Thank you for your time!

Final Discussion

References

- Anderson, W. 1983. Weed Science: Principles. St. Paul MN: West Publishing Co.
- AVRDC. 1990. Vegetable production training manual. Asian Vegetable Research and Development Center. AVRDC Publication No. 90-328. Shanhua, Tainan.
- De Putter, H., M. van Koesveld, and C. de Visser. 2007. Overview of the Vegetable Sector in Tanzania. AfriVeg Report 1.
- DIPR. 2017 Nutrition Country Profile United Republic of Tanzania. Development Initiatives Poverty Research Ltd. Retreived from https://globalnutritionreport.org/nutrition-profiles/africa/eastern-africa/united-republic-tanzania/
- DOA, Forest and Fisheries. 2013. African Nightshade: Production Guidelines. DOAFS: Pretoria.
- Everaarts, A., H. de Putter, and W. Amon. 2011. A survey of field vegetable production in Tanzania: Recommendations for improvement. Wageningen UR, Afriveg Project no. 32.500.713.11. Retreived from http://edepot.wur.nl/195026
- FAO. 2015. Training Manual for Organic Agriculture. Retrieved from https://resources.peopleinneed.cz/documents/242-fao-training-manual-for-organic-agriculture.pdf
- Lin, L., Y. Hsiao, and C. Kuo. 2009. Discovering indigenous treasures: Promising indigenous vegetables from around the world. AVRDC Publication No. 09-720. AVRDC. Taiwan: The World Vegetable Center.
- Lin, L., G. Luther, and H. Peter. 2015. Raising Healthy Tomato Seedlings. Asian Vegetable Research and Development Center. AVRDC Publication No. 15-795. Shanhua, Tainan.
- Msogoya, T., and D. Mamiro. 2016. Effect of improved tomato cultivars on productivity and profitability in Morogoro region, Tanzania. *Journal of Animal & Plant Sciences*. 30(3), 4774-4780.
- Ojiewo, C. 2013. Good Agricultural Practices for African Nightshade Production in Sub-Saharan Africa. Proceedings of a Technical Consultation Workshop Held in Arusha, Tanzania, 7-8 December 2009. Belgium: ISHS.
- Swiader, J., and G. Whitaker. 2002. Producing Vegetable Crops. 5th Ed. Danville, IL: Interstate.
- Weinberger, K., and J. Msuya. 2004. Indigenous vegetables in Tanzania. Significance and prospects. Technical bulletin no. 31. AVRDC publication 04-600.
- Wilkinson, K., T. Landis, D. Haase, B. Daley, and R. Dumrose. 2014. Tropical Nursery Manual: A Guide to Starting and Operating a Nursery for Native and Traditional Plants. USDA Forest Service Agriculture Handbook 732. USDA: Washington, DC.