# Crop to Harvest: Improved Practices

## Part 2 of 2 of improved vegetable production program

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# Objectives

- Mulching Technology
- Fertilization Management
- Harvesting and Handling

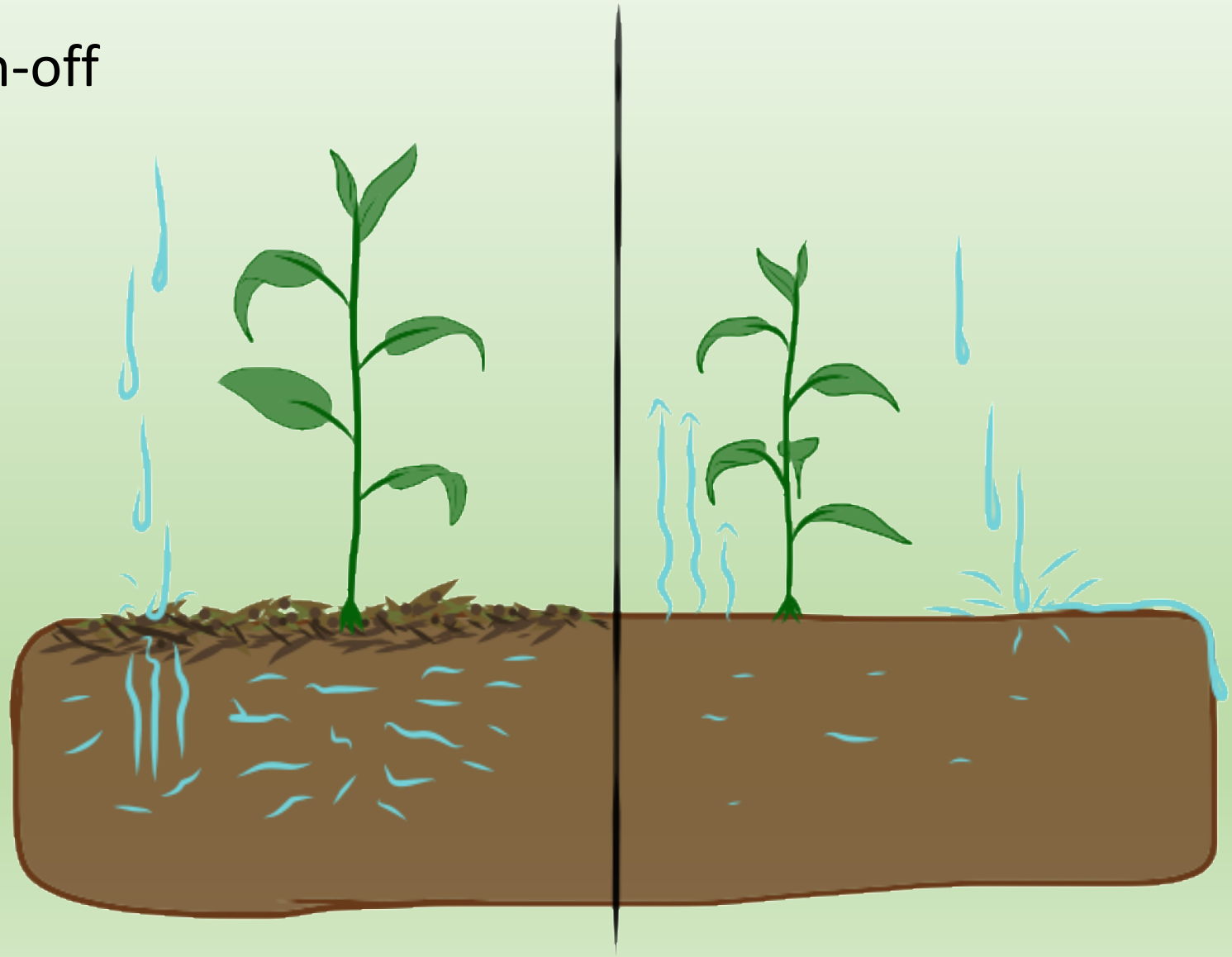
# Mulching Technology

- May be the single best practice for long term improvement in crop production

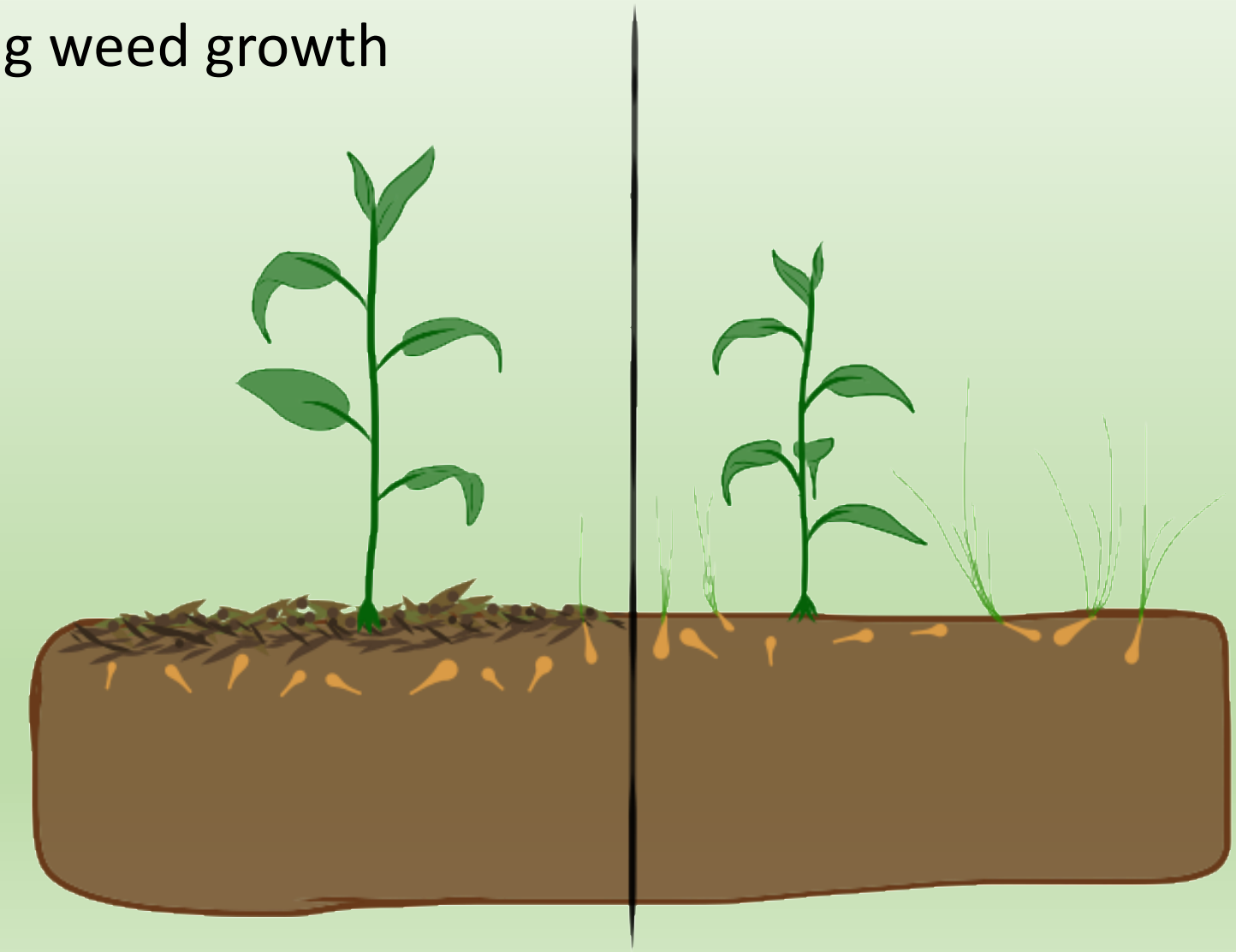
Photo credit- Kiruba Shankar
https://www.flickr.com/photos/kribs/8633930062

Photo credit- F. keeling

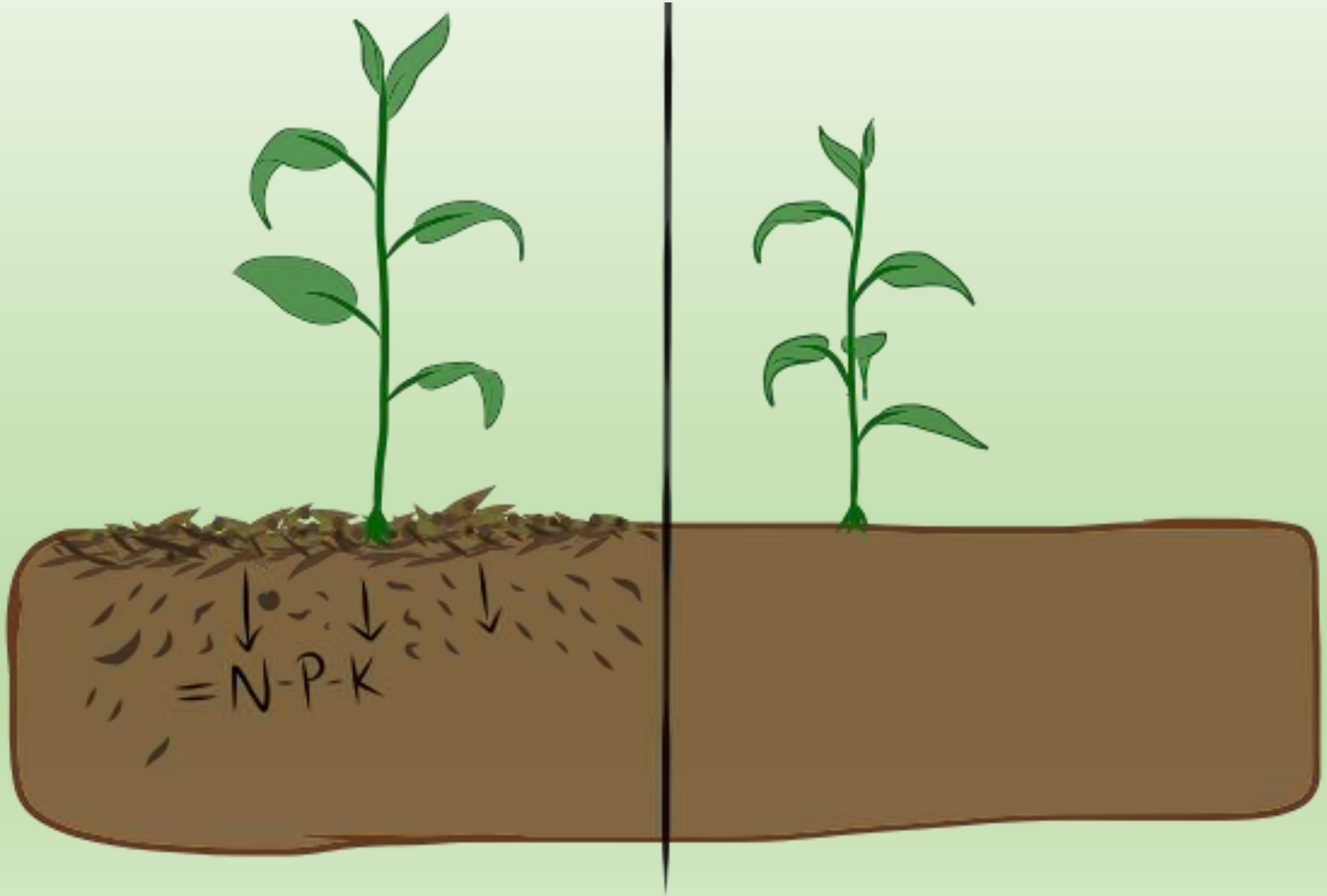
- Conserves soil water
- Less evaporation
- Stops surface water from run-off



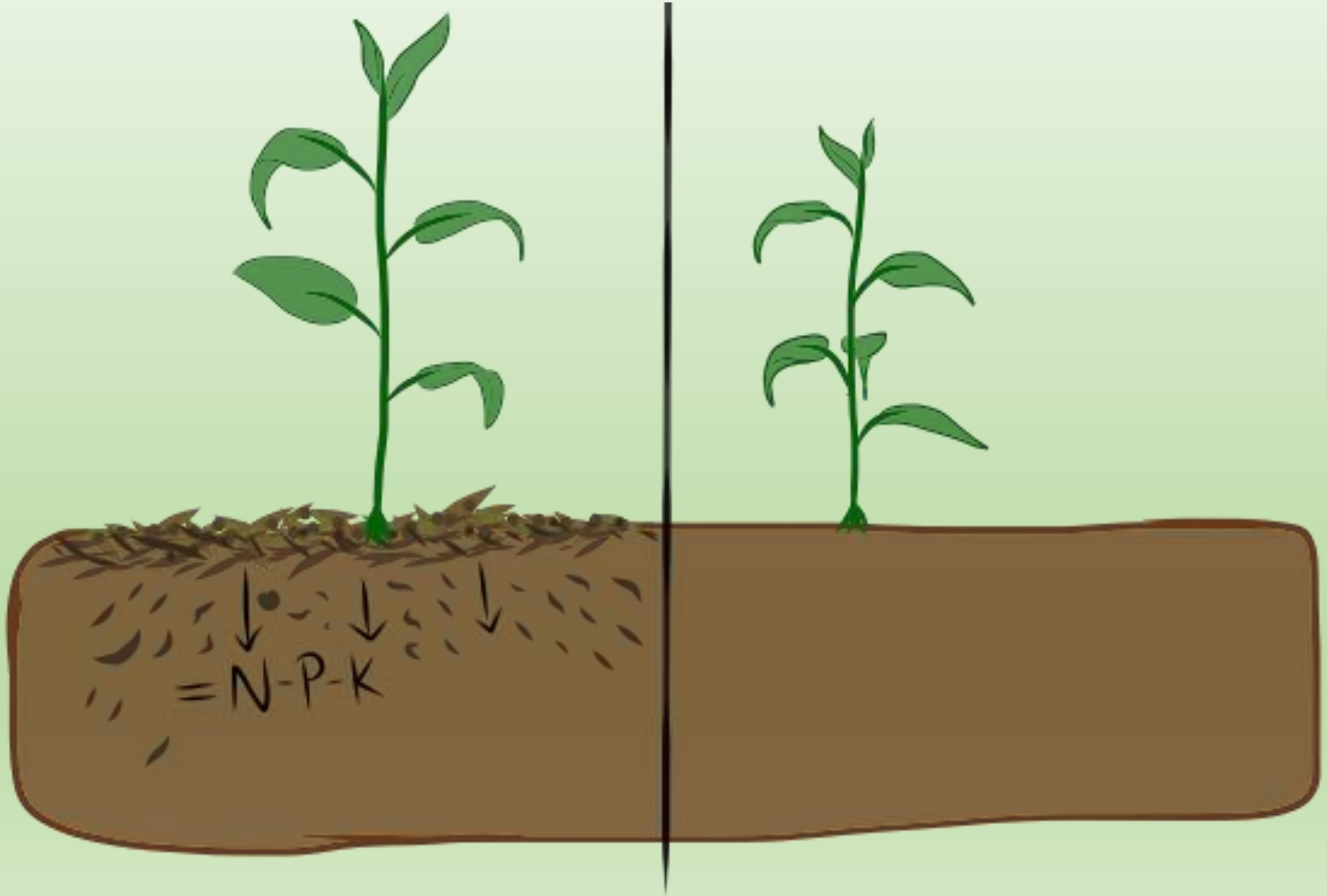
- Reduces weeds
- Smothers weeds
- Prevents sunlight from causing weed growth



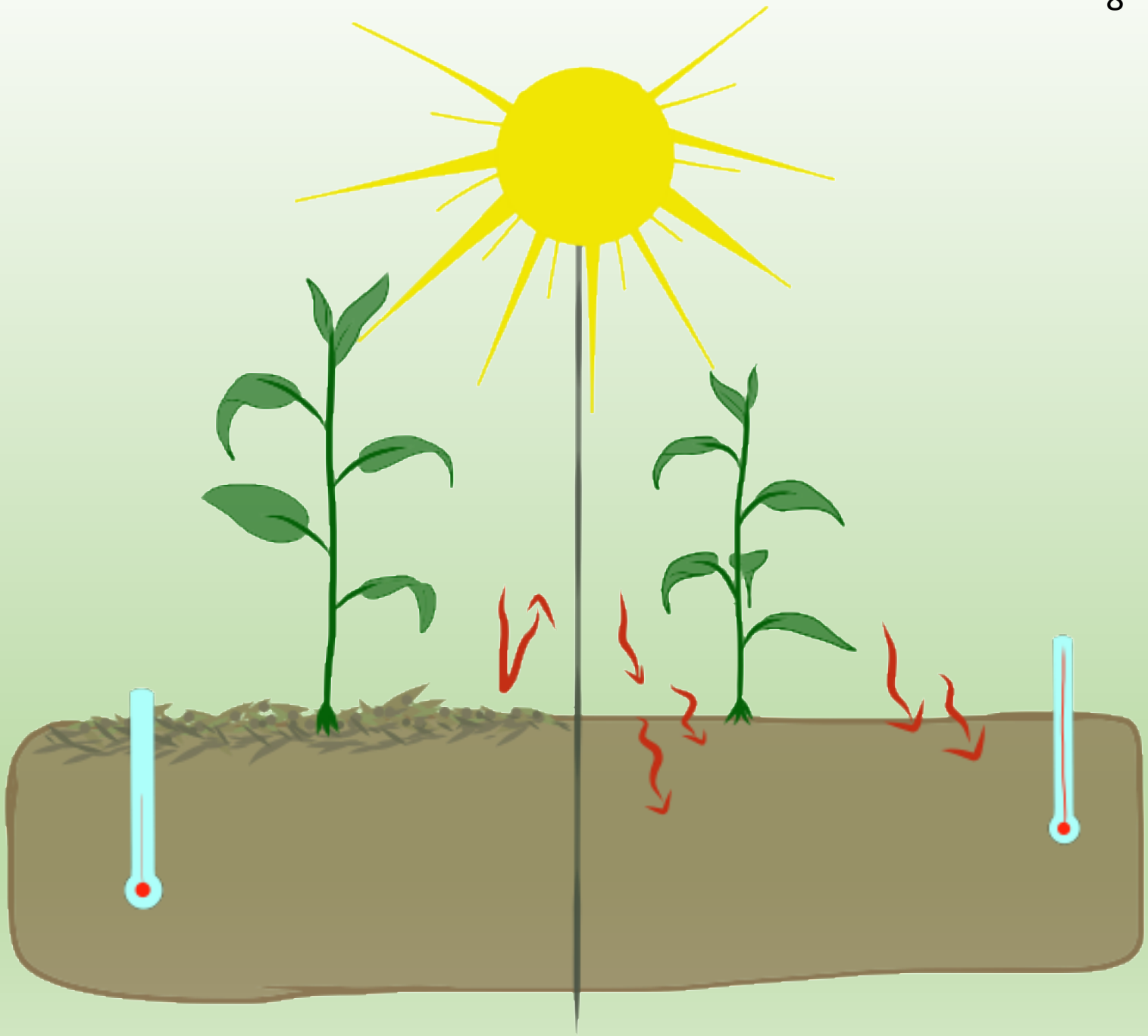
- Provides nutrients
- As mulch breaks down it turns into plant nutrients



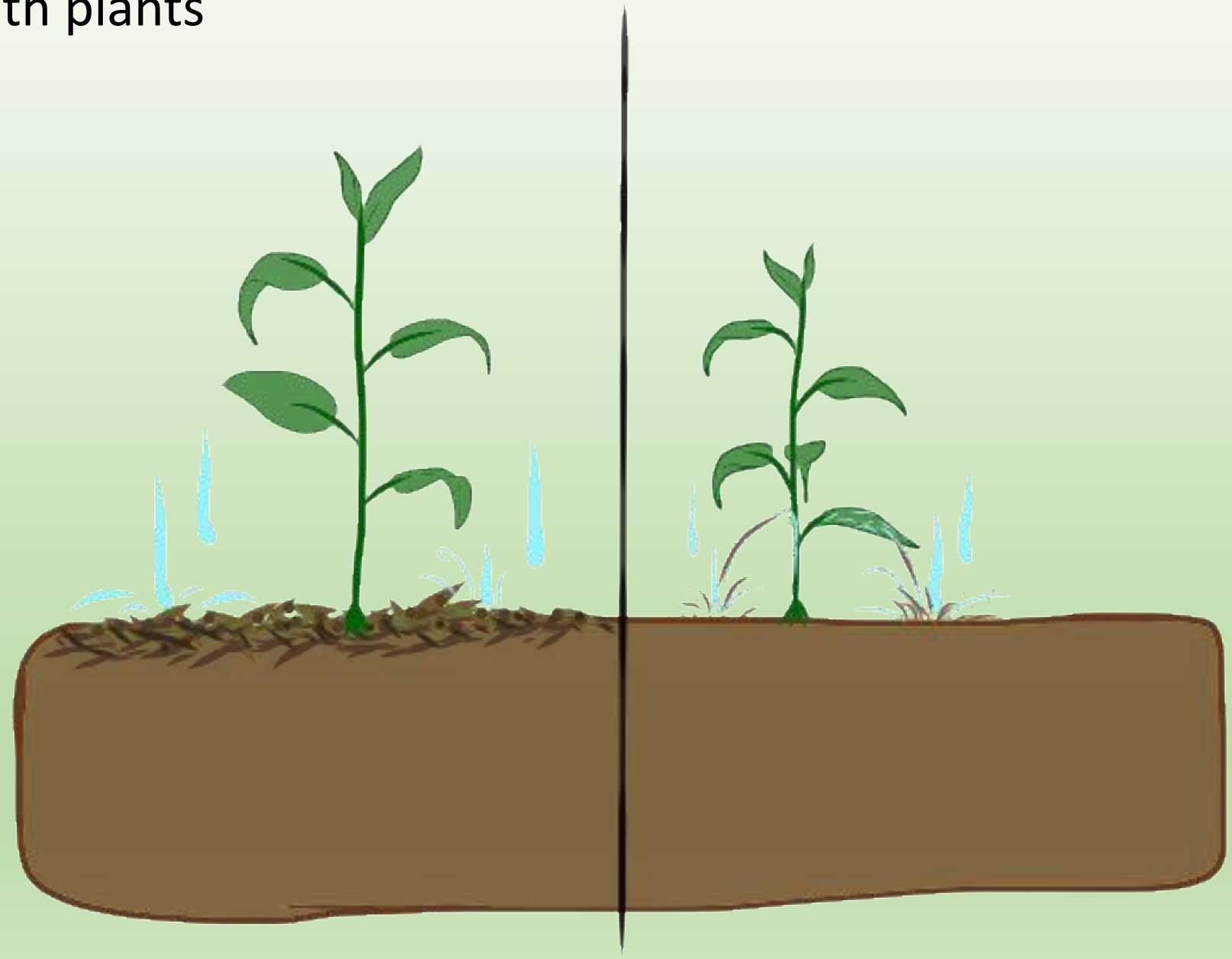
- Adds organic matter to soil
- This improves soil health



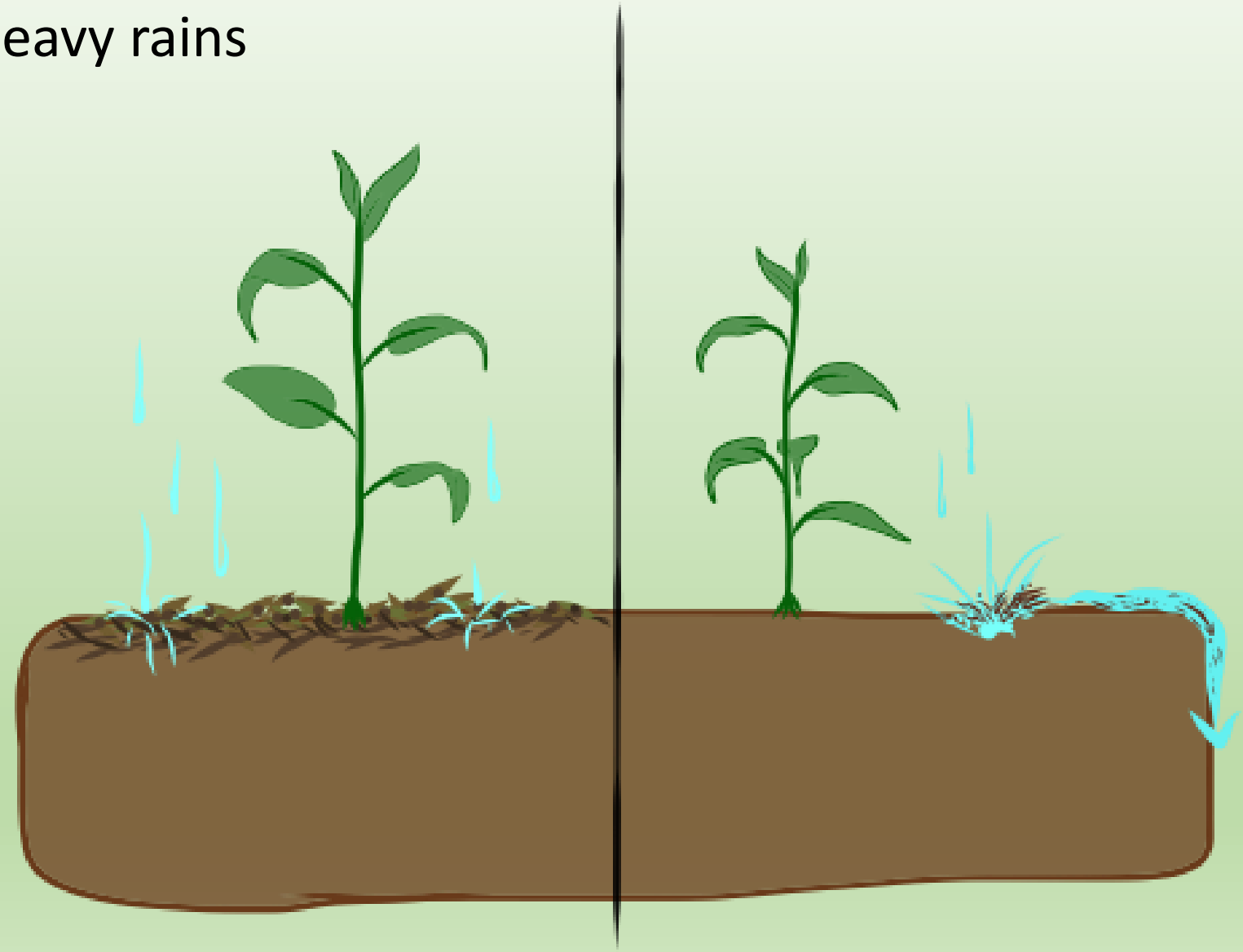
- Reduce soil temperature
- Good for plant roots



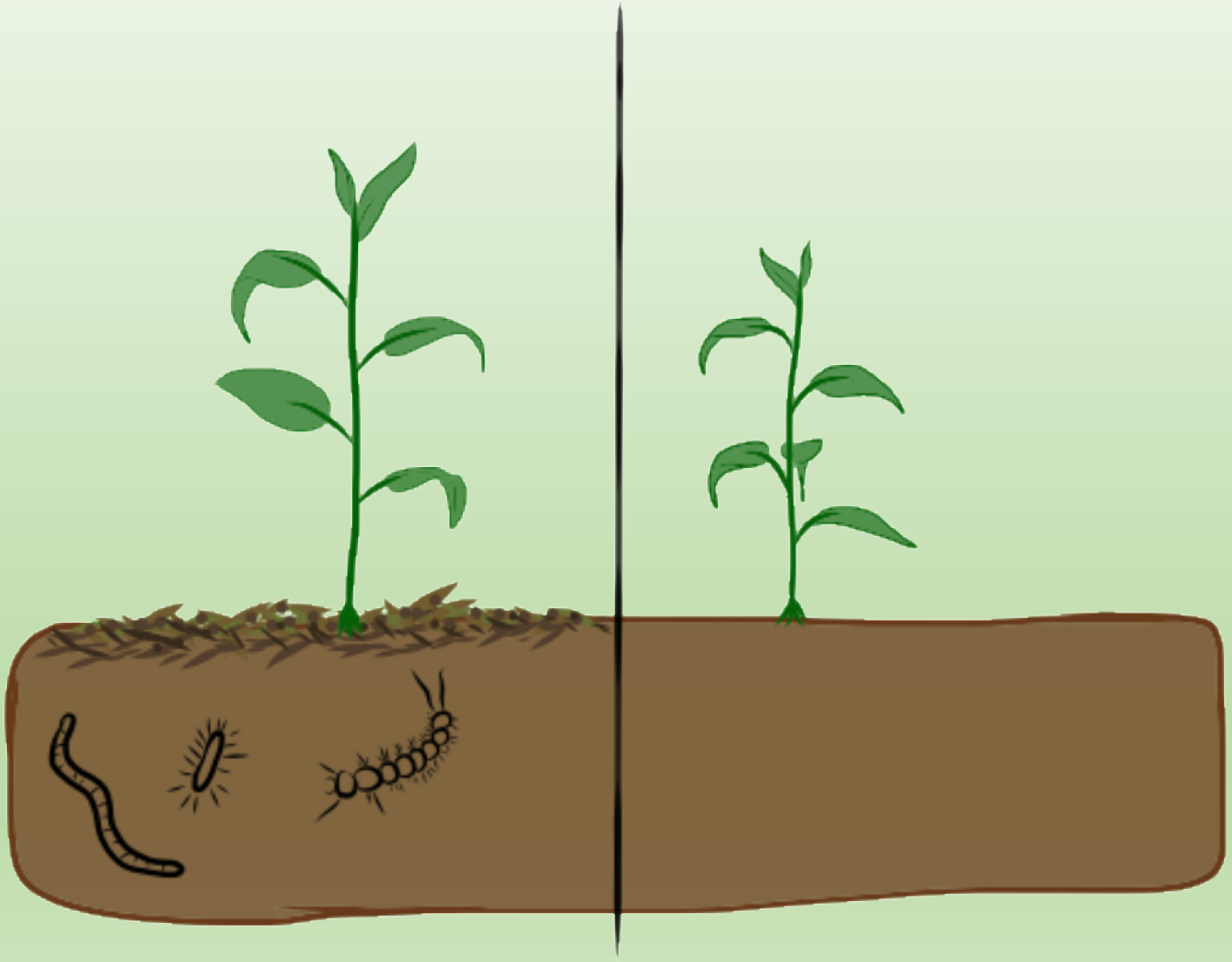
- Prevent soil contact with plants



- Protects soil surface
- Less loss of soil during heavy rains
- Benefits soil structure



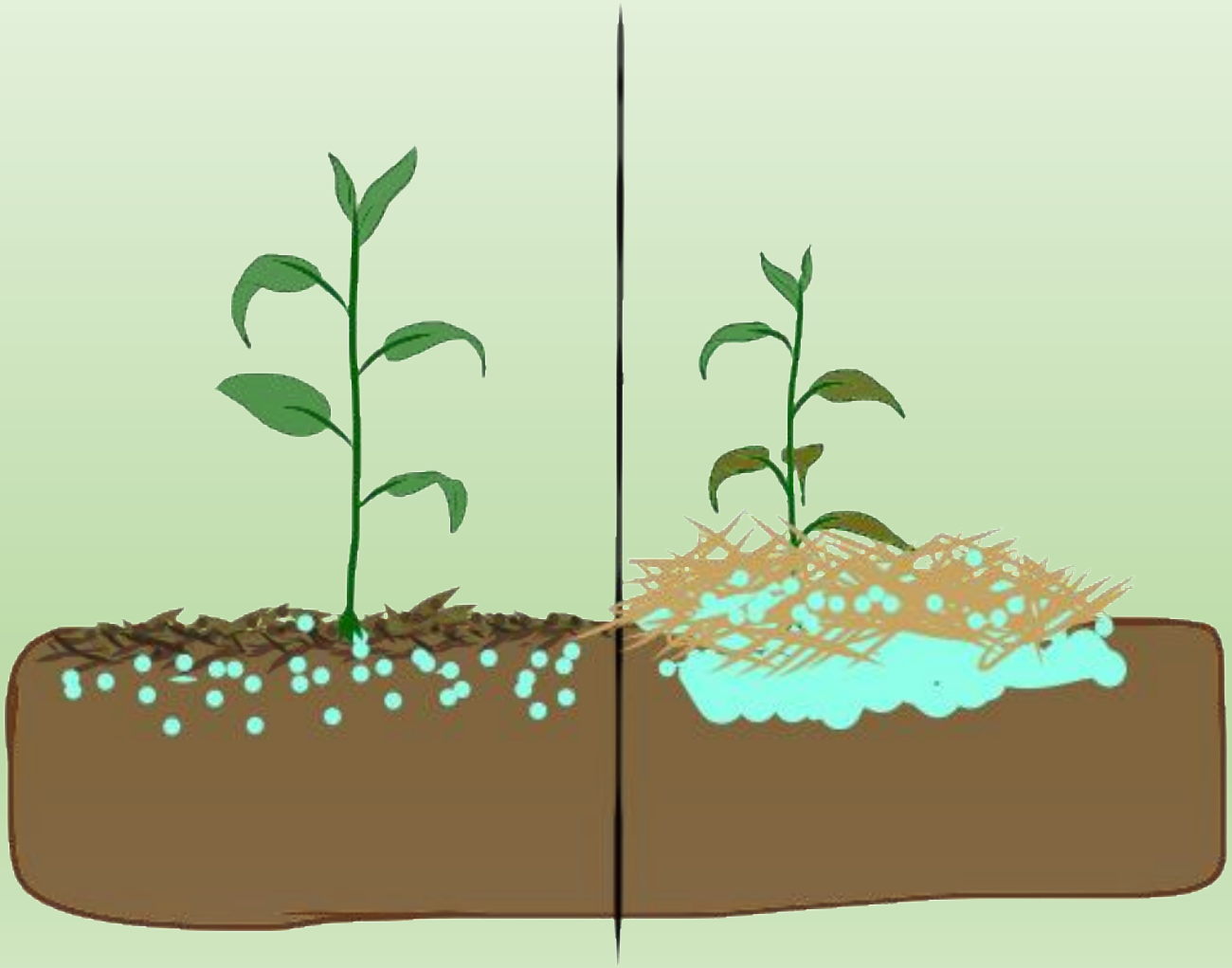
- Increase in soil microorganisms that benefit plants



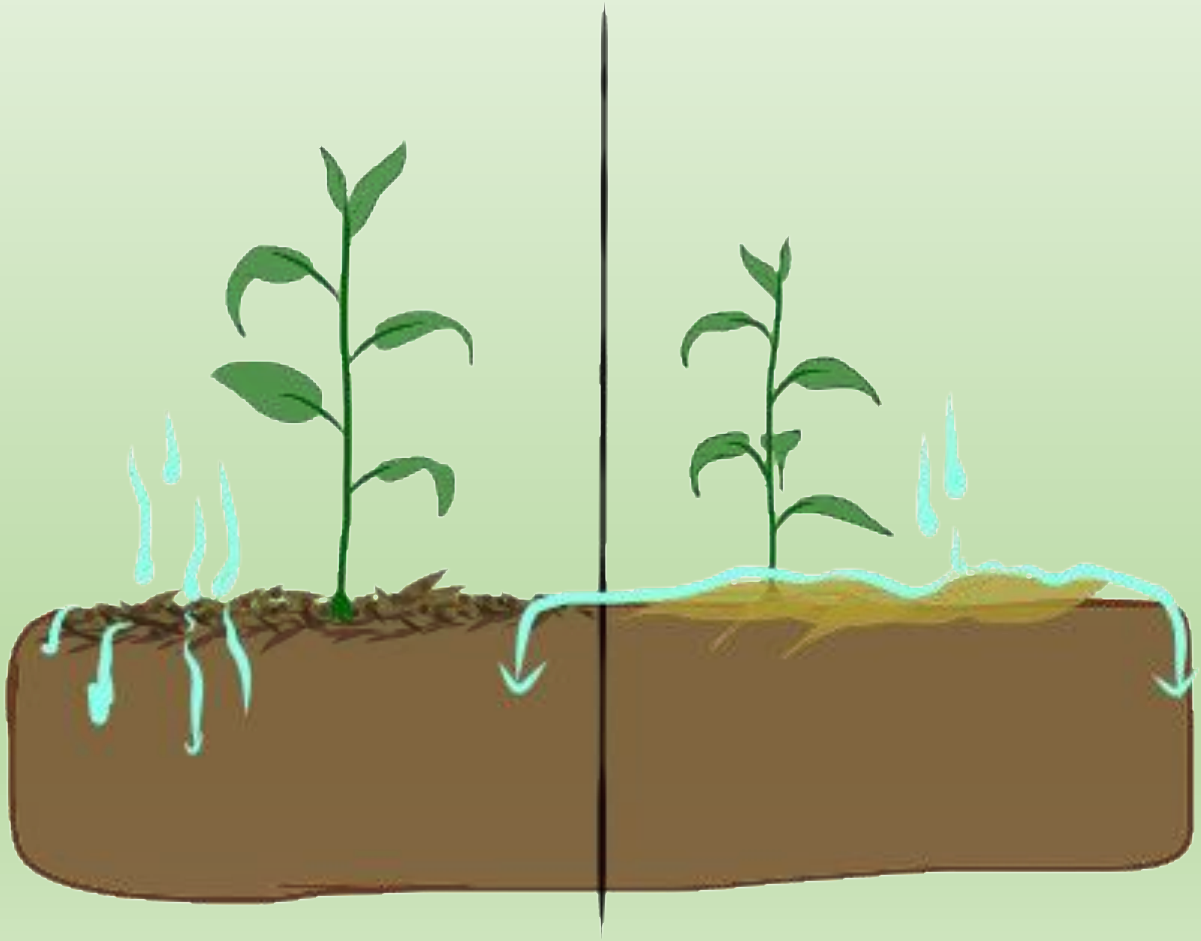
# You Must mulch properly!

- Many issues can arise from poor mulching practices

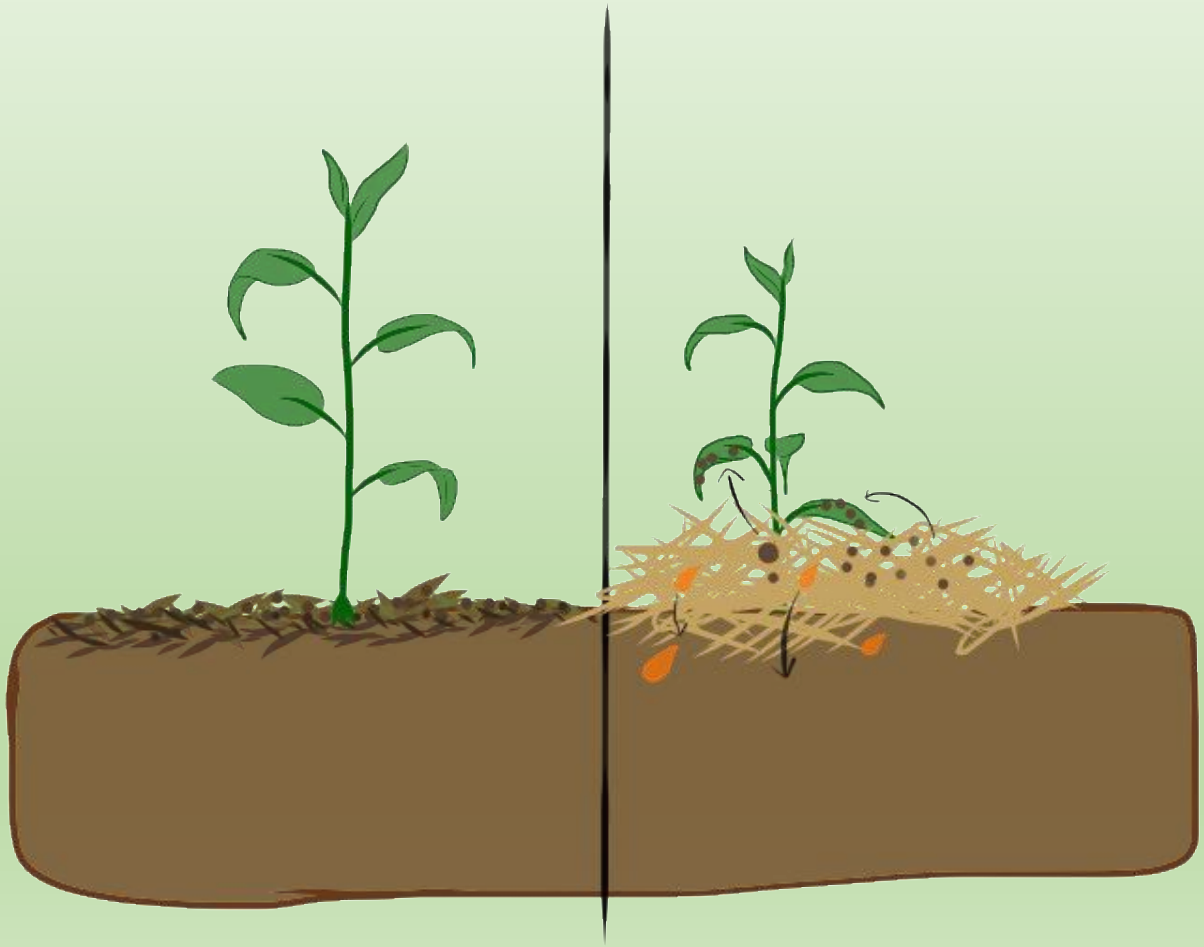
- Too much soil moisture
- Depth of mulch and type of mulch can affect this



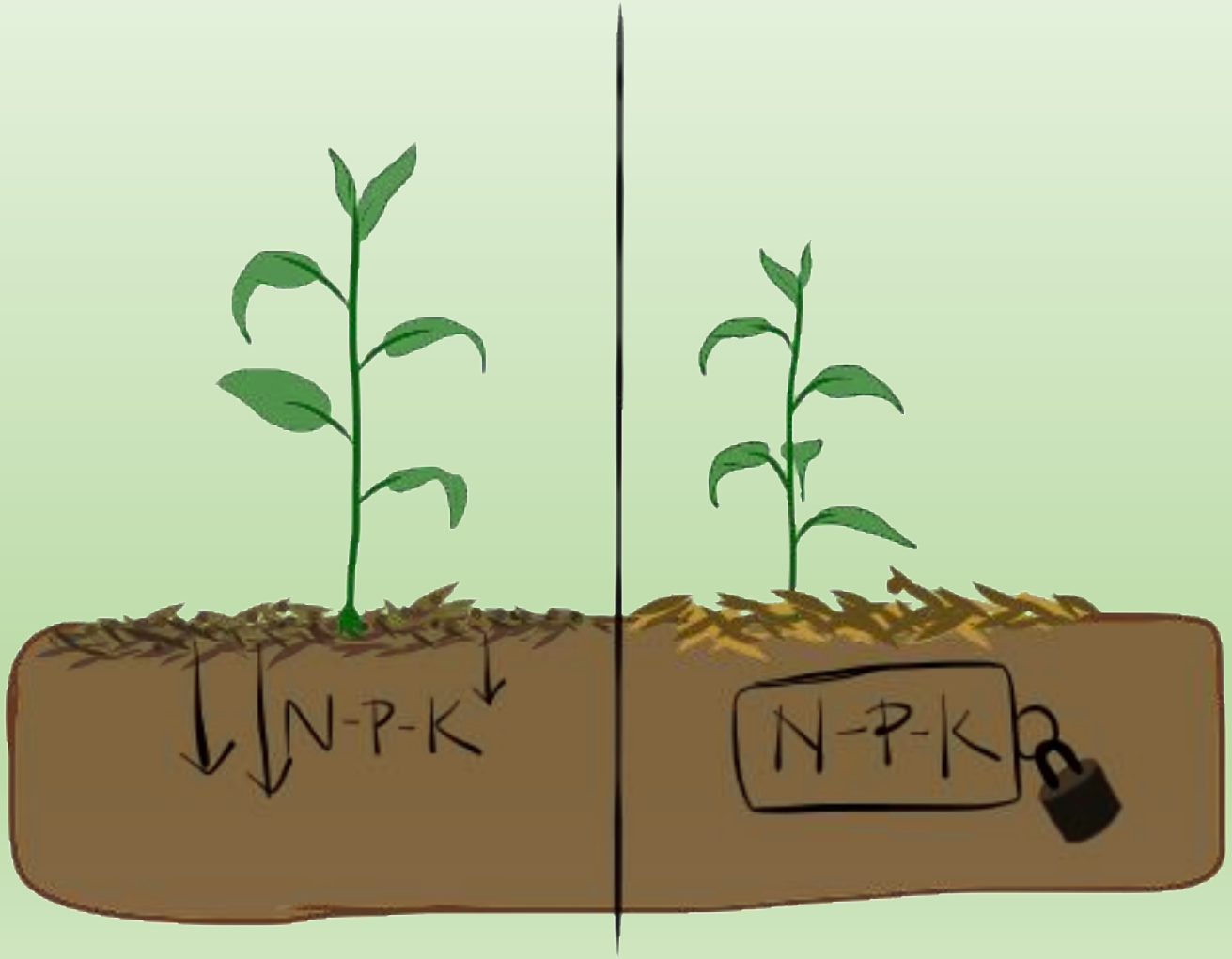
- Can prevent water infiltration
- Especially true for plastic mulches



- Can be a source of pests and diseases
- Non-sterilized mulch can have weed seeds, pests, or disease
- Use clean material or sterilize



- If not decomposed enough, mulch can reduce soil fertility in the short term



# Mulch sources

- Cover crops
- Plant residues; weeds, crops, bush plants, woody crops
- Plastic mulches
- Paper mulches

# Cover crops

- Prevent weeds when growing
- Legumes can add more nitrogen

# Cover crops

- Cut them down once the season is over
- Lay them down in the field
- Do not till
- Transplant crops

Photo credit- Rey Ramon http://www.kadena.af.mil/news/story.asp?id=123167002

# Cover crops

- At the end of the season
- Till all plant residues into the soil
- Re-plant cover crops

# Plant Residues as mulch

- Most plants can be used for creating mulches
- A mix of green and brown plant material is best
- Balanced Carbon to nitrogen ratio 25:1

# Plastic Mulch

- Low labor
- Best weed control
- Irrigation becomes more complicated
- Can heat soil

# Considerations with plastic mulch

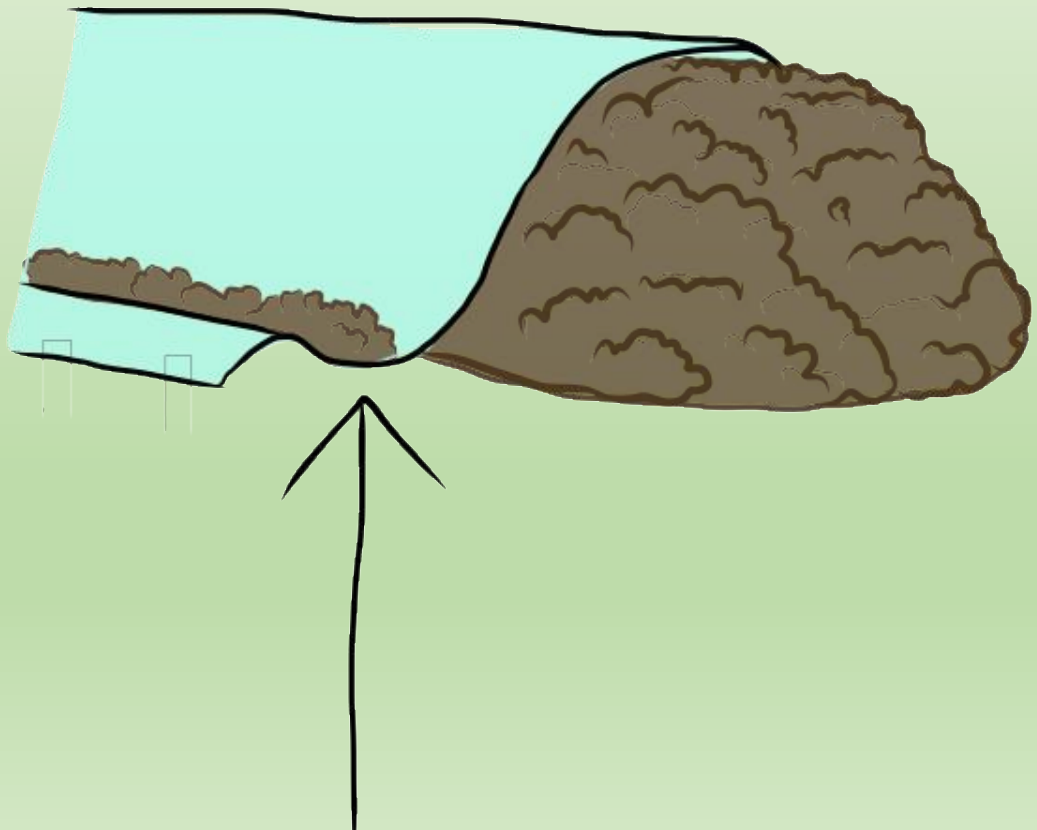
- Sheet must be wider than the planting bed
- Irrigation needs to be applied beneath the plastic
- Plastic need to be anchored
- Fertilizer needs to be supplied under the plastic
- Multiple years of constant plastic use is bad for soil

# Irrigation

- Drip or furrow

# Anchoring

- Pile soil on all edges
- Sod pins



# Fertilizer

- Compost, manure, slow release fertilizer
- Put down before applying plastic

# Color

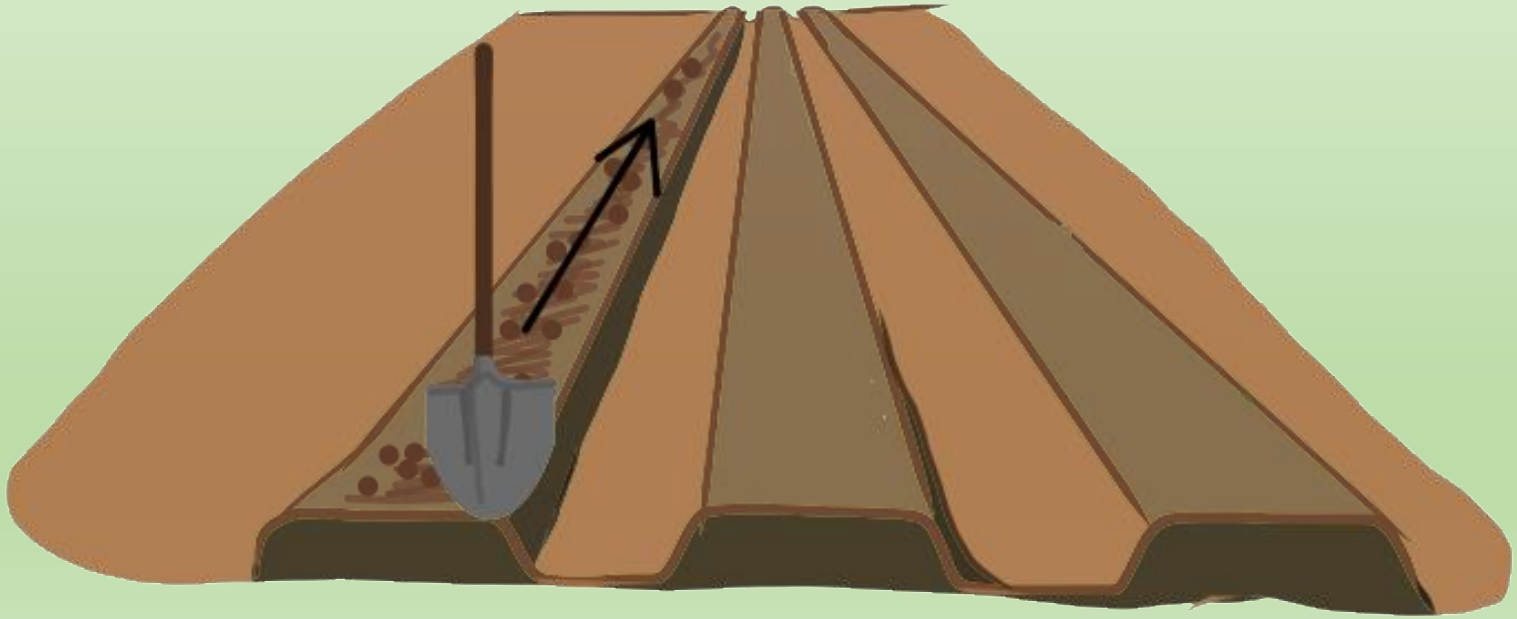
- Usually black or white
- White is best for tropics
- Does not absorb heat as easily
- Reflects sunlight to promote plant growth

# Rotating plastic use

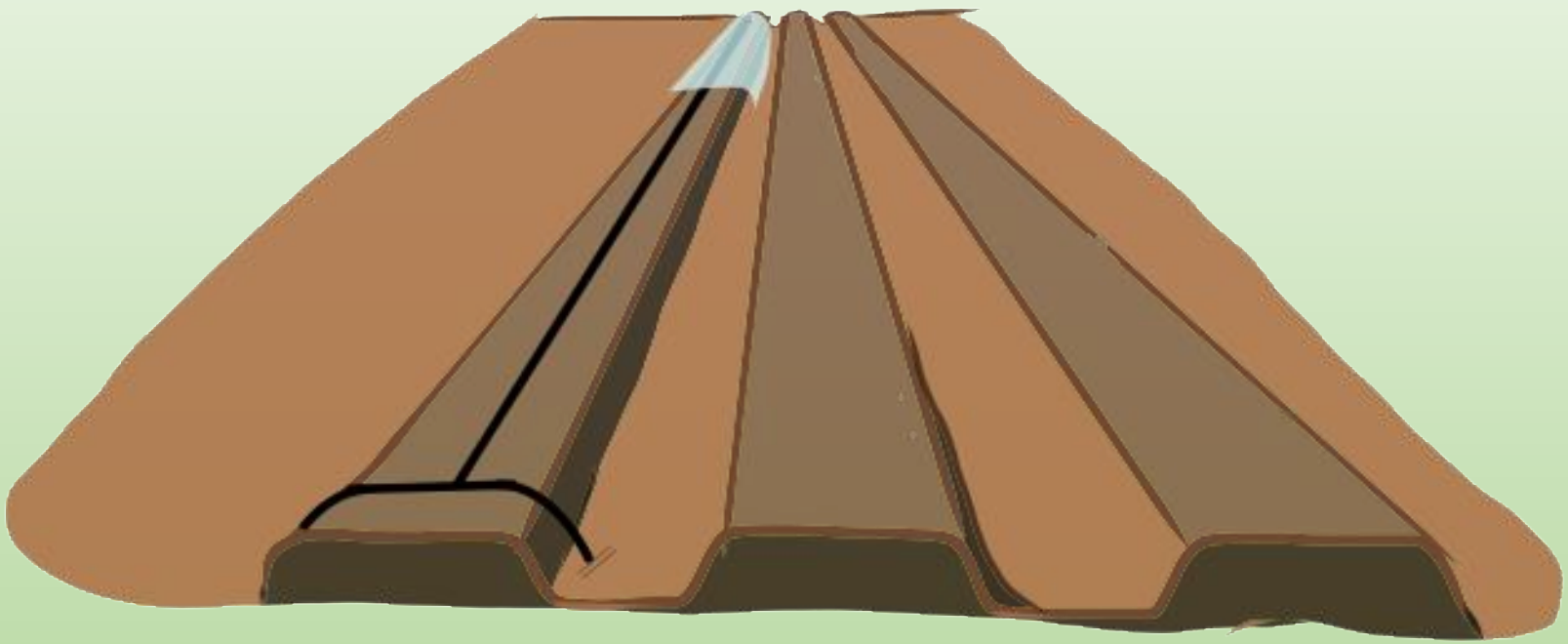
- Is done much like crop rotation
- Only use plastic on the same soil every 3 years

# Installation of plastic mulch

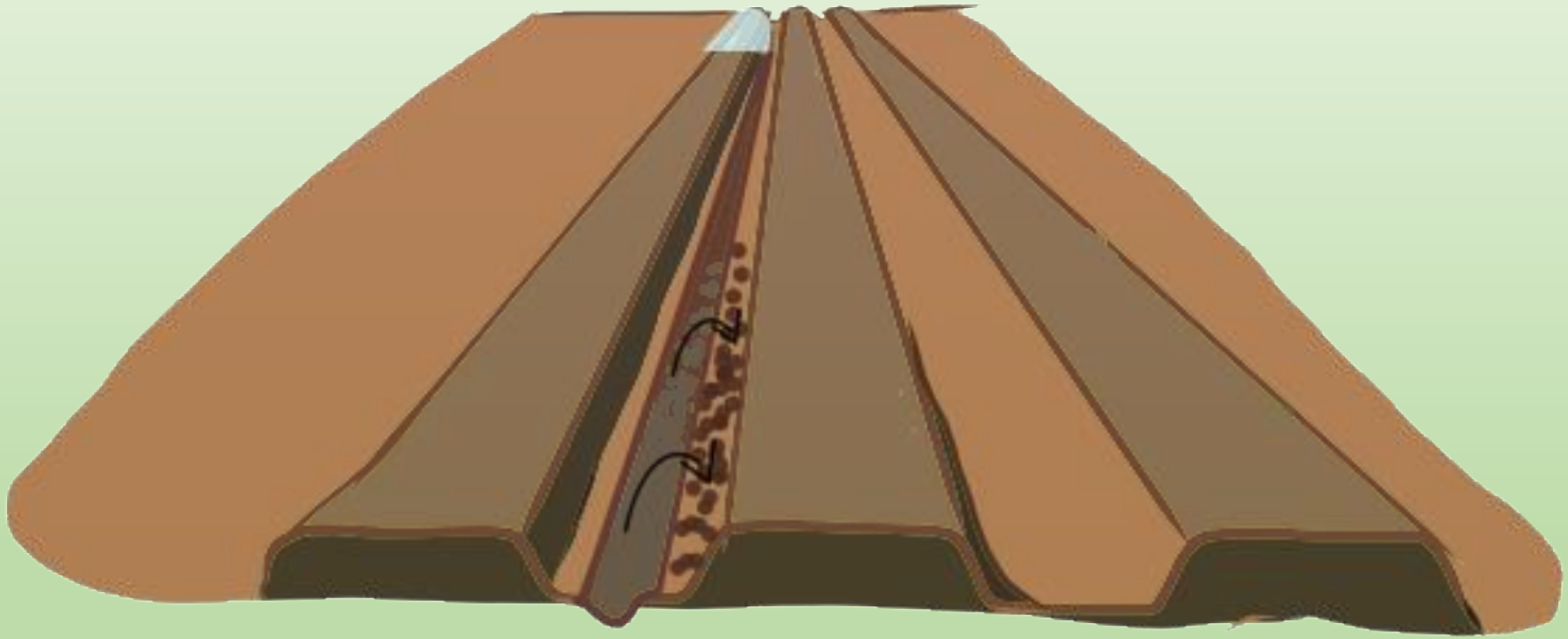
- Prepare soil by tilling, cutting back weeds or cover crops and incorporating fertilizer, manure or organic matter



- Install drip irrigation if necessary

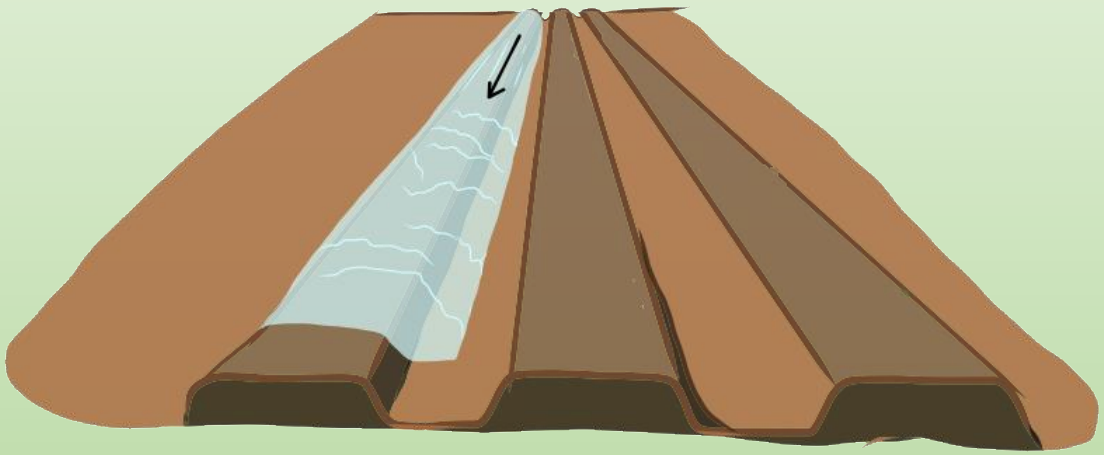


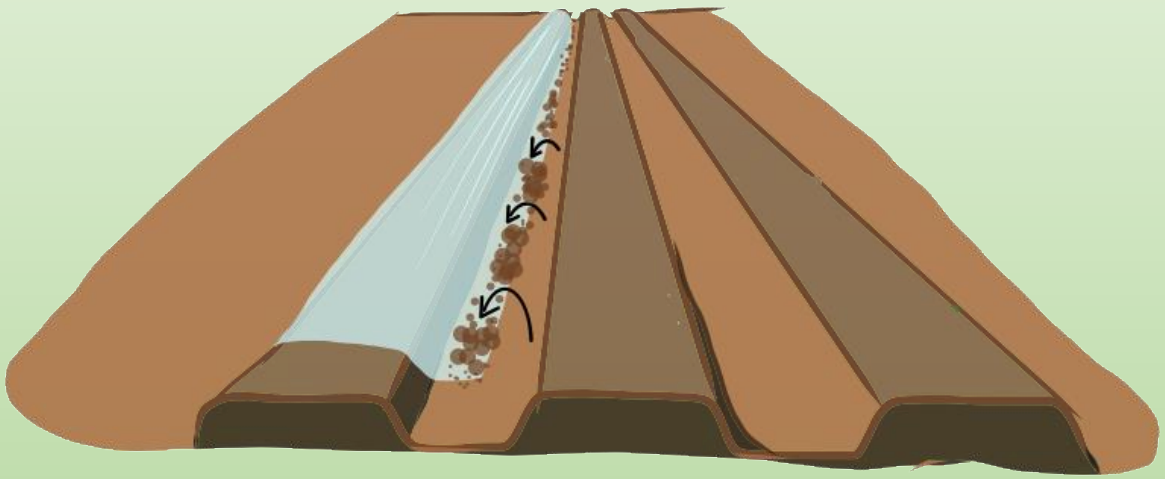
- Move a small furrow of soil from the edges of the planting row at the width of the plastic sheet



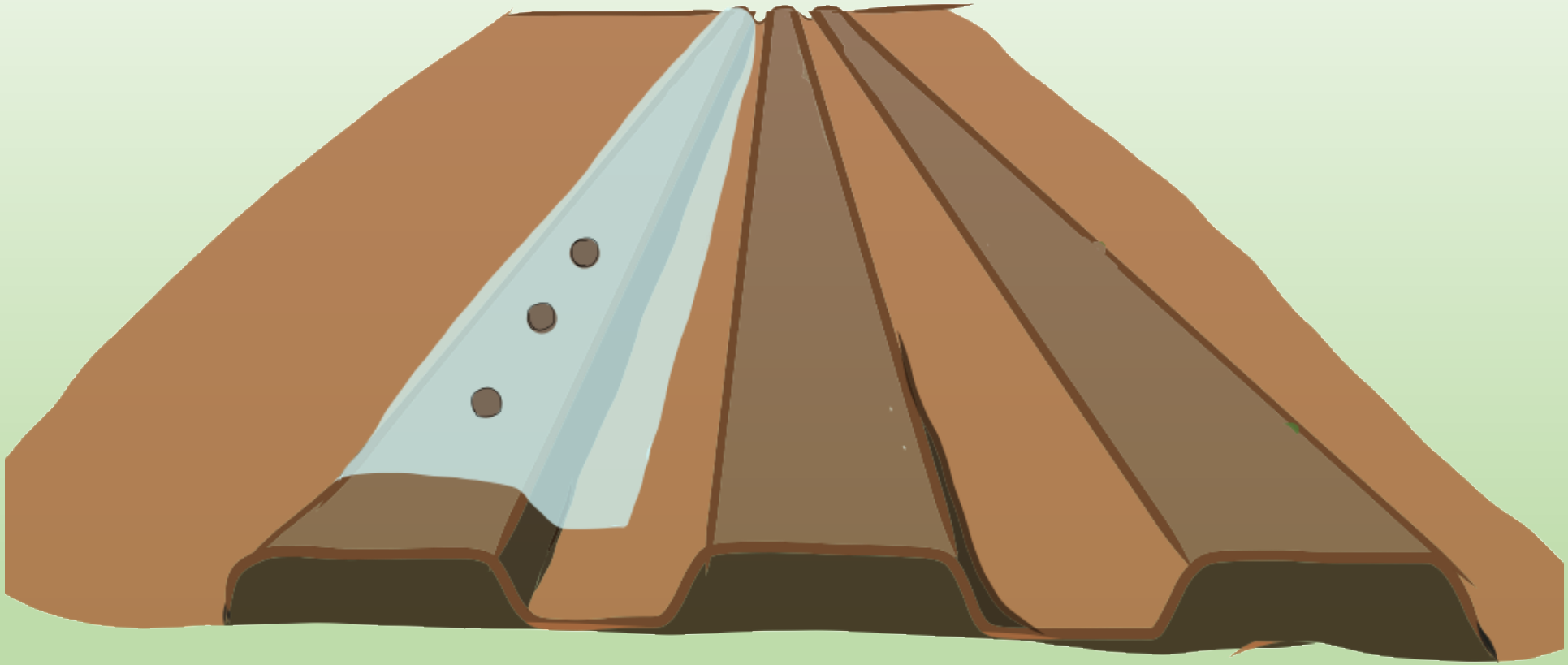
- Install the plastic sheeting
- Tighten the sheet
- Lay some soil or rocks to keep it in place if necessary

- Begin to tighten the plastic and lay the soil over the edges





- Prepare planting holes in the plastic



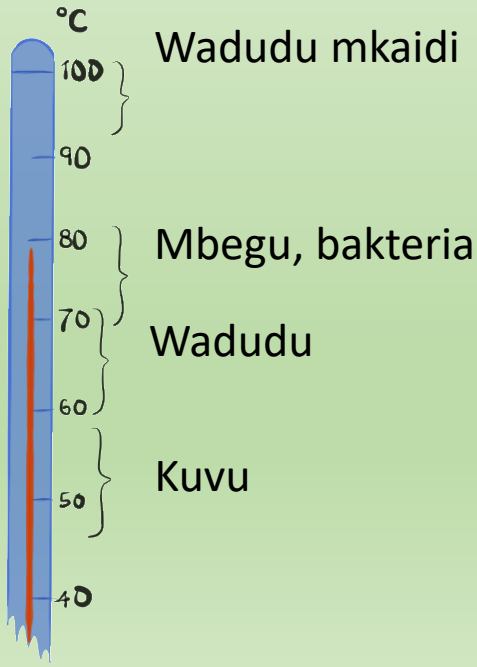
# Straw Mulch

- Up to 8 inches thick
- Do not apply too close to the plant
- The thicker it is the more it works, but also the more likely disease could occur

- Can be used with plastic, other plant residues, or manures

# Composting Process

- Kills pests and diseases
- Releases nutrients
- Requires microbes, oxygen, moisture, and organic matter



- Green Matter vs. brown matter
- Applying nitrogen fertilizer will help this process

# Making Compost

- Prepare the pile of compost by mixing all materials evenly
- Wet the compost to the point of fully wet
- Between 1 and 2 meters tall and wide

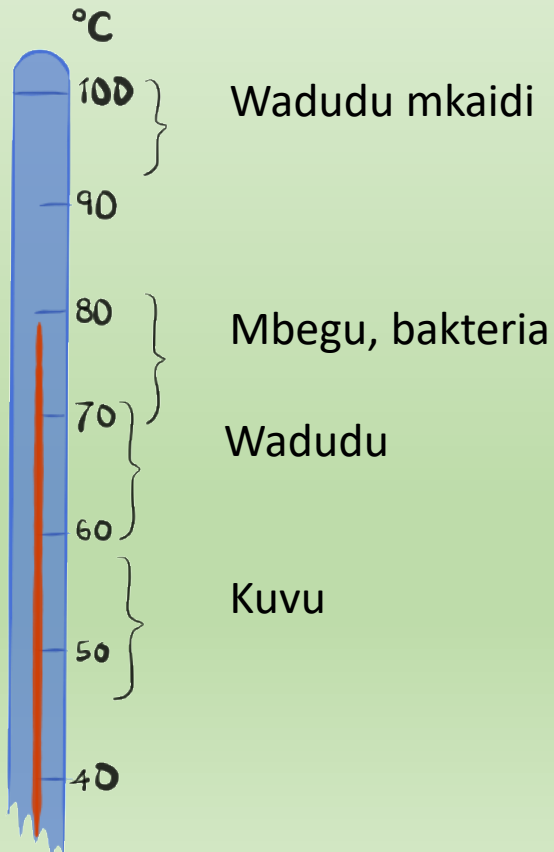
- Moisten the pile whenever it dries out
- Every two to four weeks turn the pile
- Do this for three months

- The compost should be getting very hot and steaming when you turn it.
- Good compost when finished will be dark brown with no large recognizable pieces of plant material

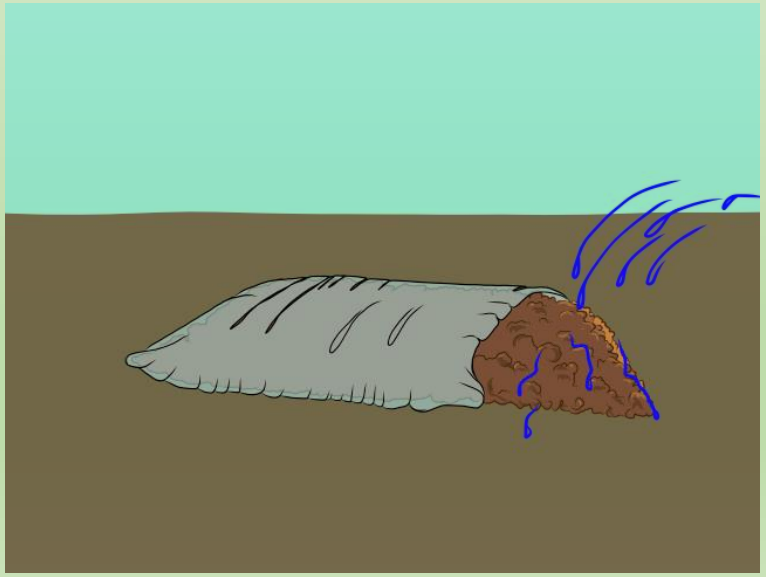
Photo credit- Kylie Wong

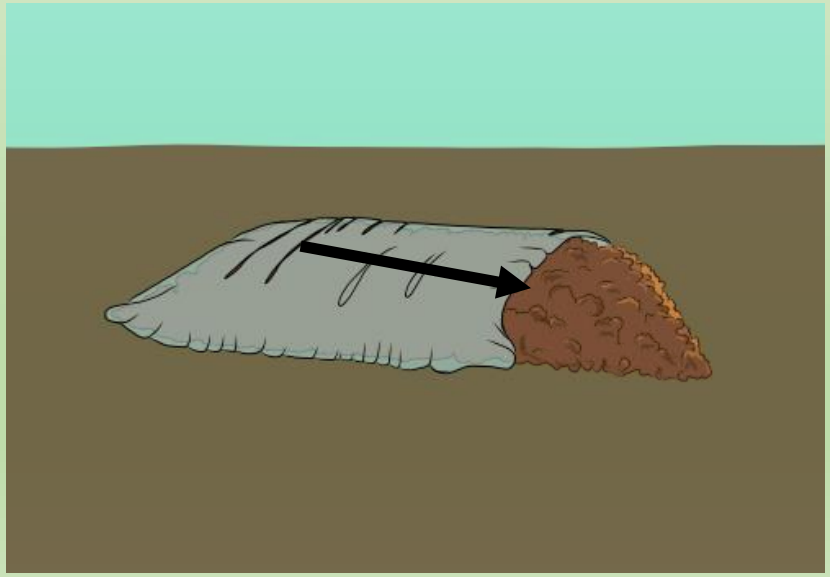
# Sterilizing Mulch

- Mulches and composts can be sterilized to make sure there are less weed seeds, pests, and diseases.



- Completely wet the mulch
- Cover mulch with a plastic sheet with no holes in it
- Seal the edges with soil
- After 3-4 weeks remove the plastic





# Discussion

- Who uses mulch?
- What are your mulch sources?
- Do you compost?
- How much mulch do you need?
- What are your hesitations about using mulches?
- Do you have anything you want to share with me?

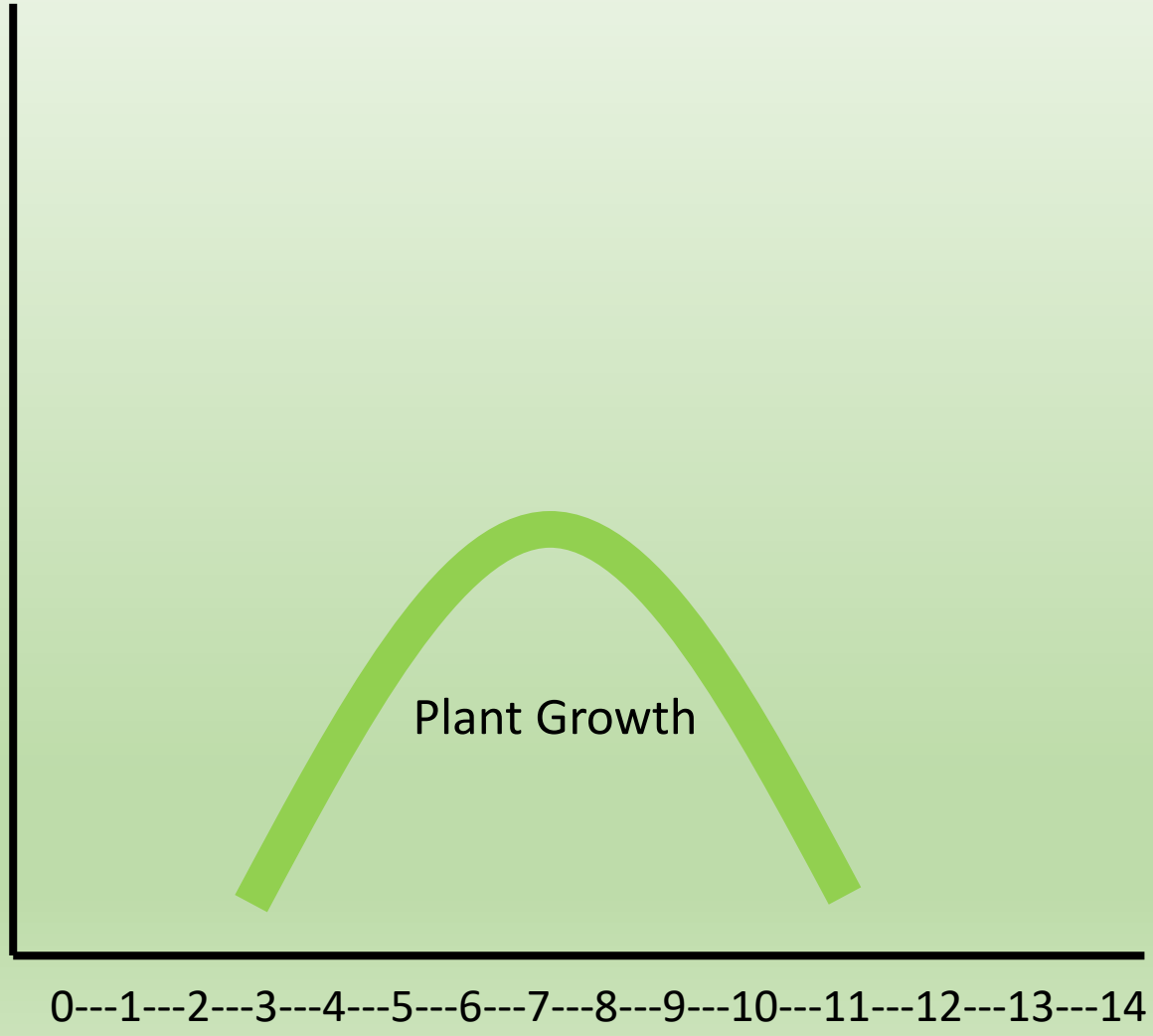
# Fertilizer Management

- Farms will always need addition of fertilizer in intensive agriculture
- In the tropics nutrients are leached through the ground very easily
- Soil properties affect availability of nutrients


C
N
P
Fe
K
Mn
Mg

# pH

- Measurement of how acidic the soil is
- pH needs to be in a certain range
- Normally 6-6.5 pH is best.



# Soluble Salts

- Kill plant roots, make soil unusable
- Added by too much fertilizer, polluted water

# Normal fertilizer formulas

- N-P-K, most limiting nutrients generally
- Listed as a percentage
- 10-10-10 fertilizer will have 10% of each nutrient
- So a 22kg bag will have 2.2 kg of each nutrient in it

- Analyzing your soil can help A LOT
- Soil sampling tells you how much of each nutrient you have in the soil.

# Fertilizer requirements

| Time | Nitrogen | Phosphorous | Potassium | Calcium | Magnesium |
|---|---|---|---|---|---|
| **Pre-planting** | 45 kg/ha | 50 kg/ha | 50 kg/ ha | 0 kg/ha | 0 kg/ha |
| **Week 0-6 growth** | 45 kg/ha | 18 kg/ha | 50 kg/ha | 10 kg/ha | 8 kg/ha |
| **Week 6-12 Flower and fruiting** | 45 kg/ha | 18 kg/ha | 100 kg/ha | 70 kg/ha | 13 kg/ha |
| **Week 12-18** | 45 kg/ha | 12 kg/ha | 100 kg/ha | 55 kg/ha | 3 kg/ha |
| **Total** | 180 kg/ha | 98 kg/ha | 300 kg/ha | 135 kg/ha | 24 kg/ha |

# Tomato

- Compost or manure at 20 tons a hectare
- Calcium and magnesium are very important for fruit
- N-P-K at 10-10-20 at a rate of 60 kg/hectare before planting and 20, and 40 days after.
- Calcium and Magnesium!

# Eggplant

- Compost at a rate of 20 tons per hectare
- 10-10-20 N-P-K fertilizer at 200 kg/hectare at 0, 20,40, and 60 days

# Nightshade

- Compost at 5 tons per hectare
- N-P-K fertilizer at 60 kg N, reapplied after every 2-3 harvests

# Organic matter as fertilizer

- Manures and composts- 5% or lower N amount
- Slowly released, and must be applied prematurely

Photo credit- Luke Baker, Brookside Laboratories, Inc.

# Rotating legumes

- Use in crop rotation
- Beans and peas supply up to 32 kg N a hectare
- Alfalfa can provide 44 to 54 kg N a hectare

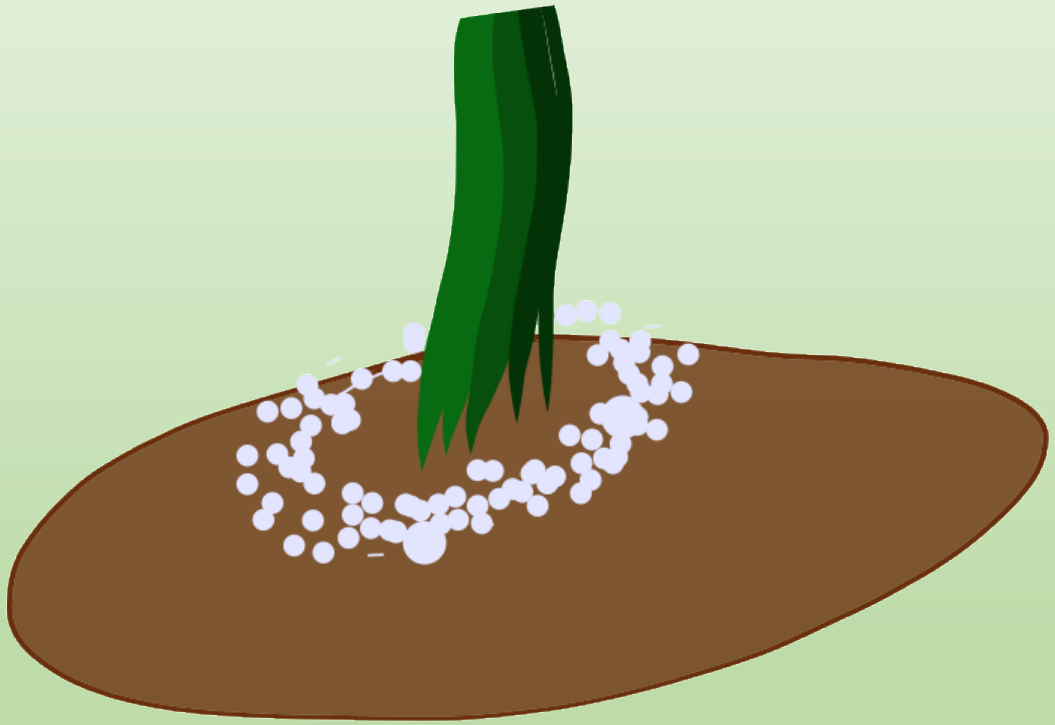

# Application methods

- Soil incorporated application
- Composts, manures, powdered fertilizer

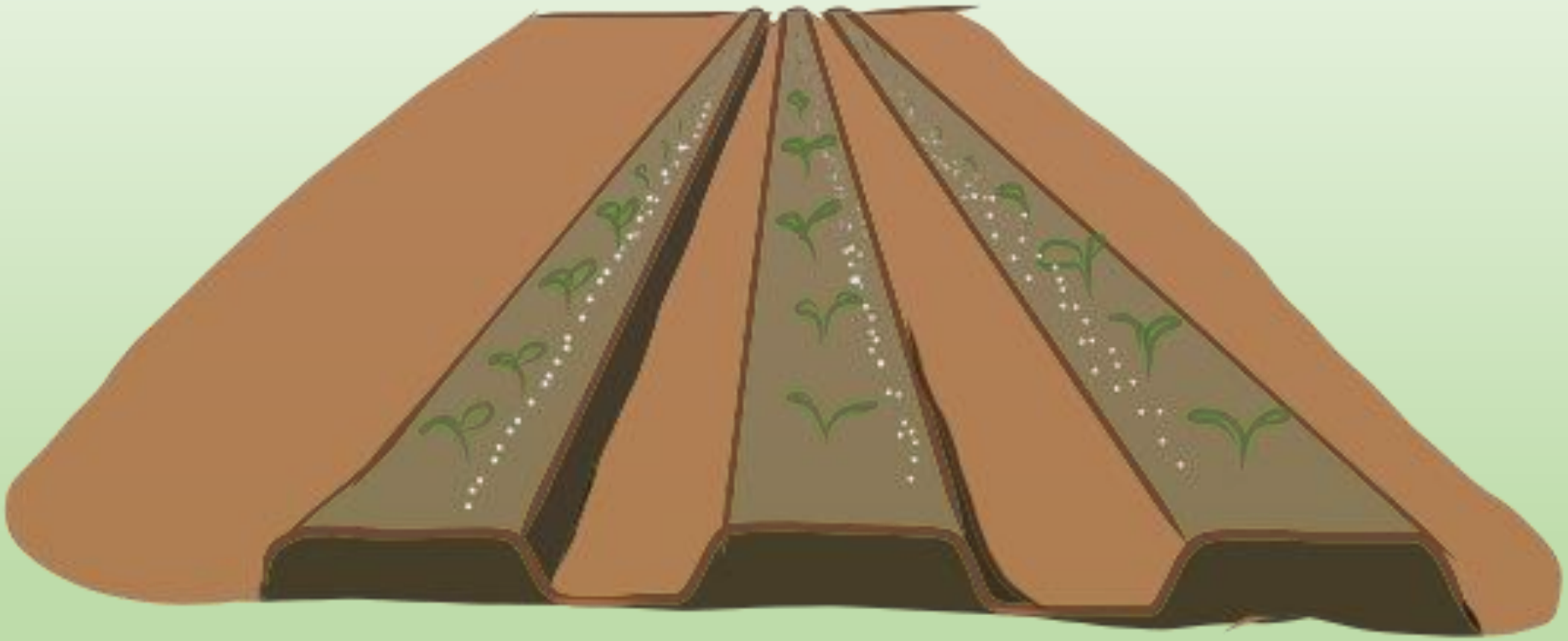
- Broadcast application
- Least accurate but fastest method

Photo credit- IRRI,https://www.flickr.com/photos/ricephotos/346308604

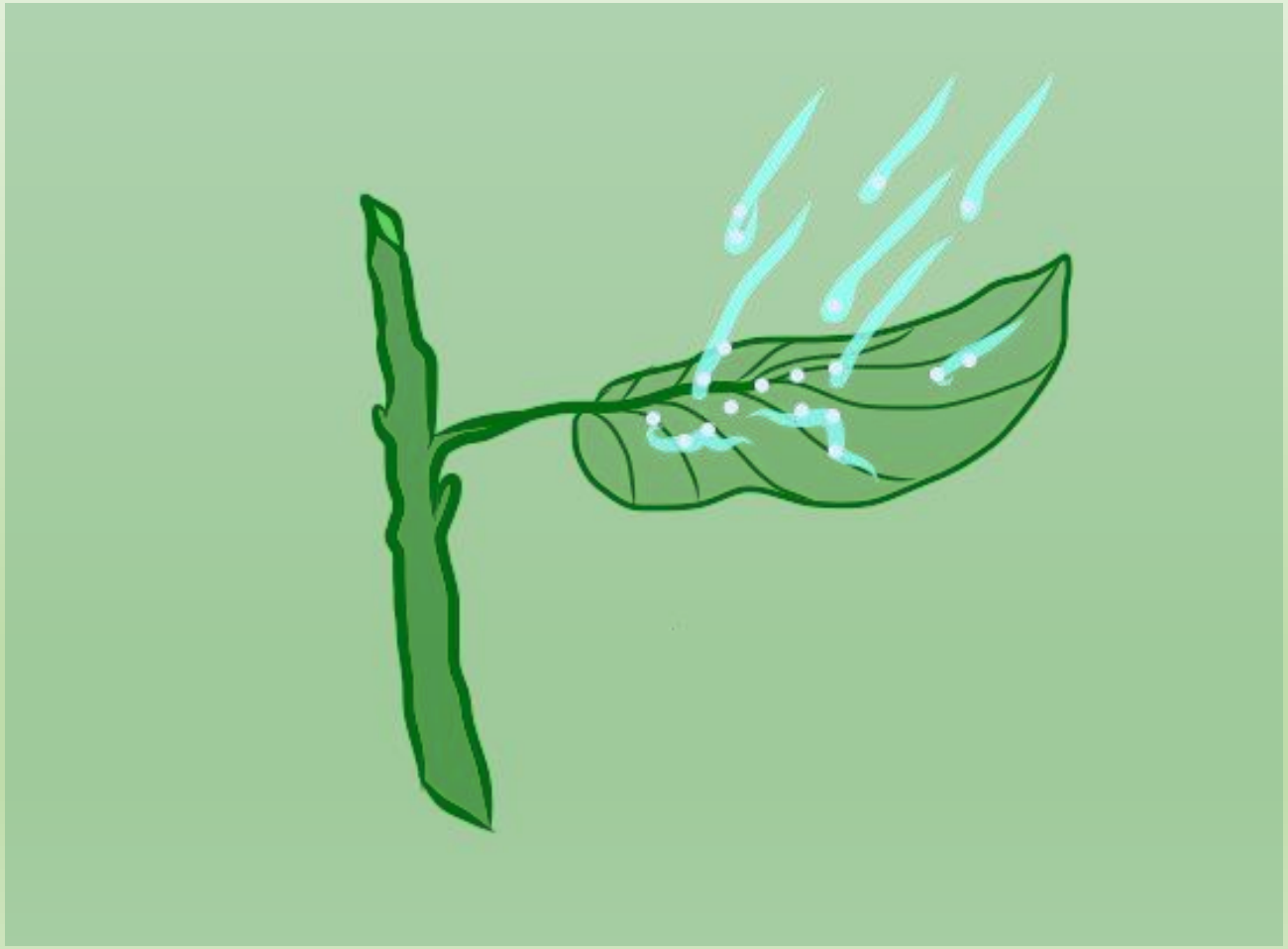
- Basal application
- Most accurate but takes most time



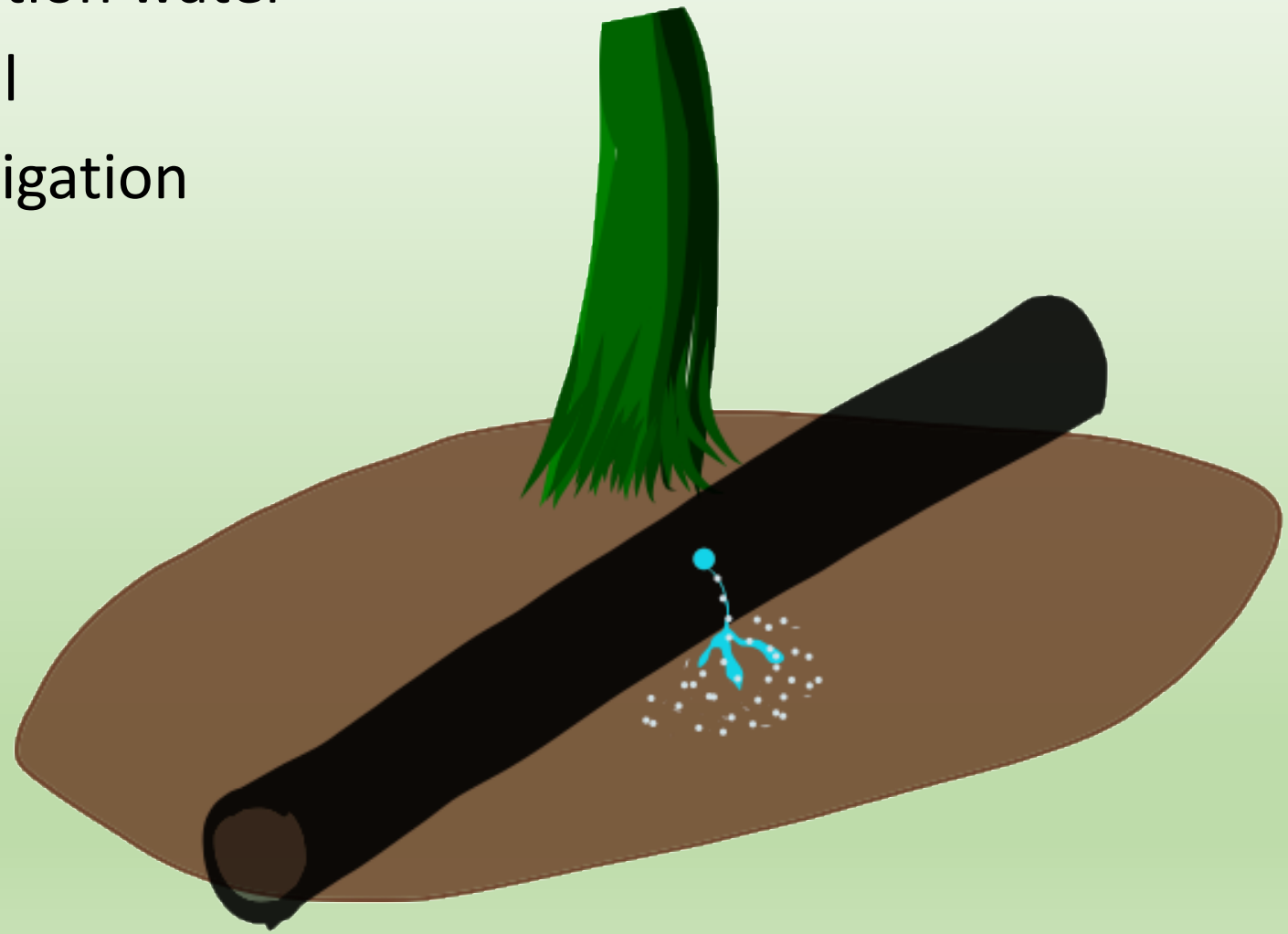
- Band applied application
- Slightly less accurate and less time consuming than band applying



- Foliar application
- Fastest acting
- Only good for certain nutrients; phosphorous, zinc, iron



- Fertigation application
- Adding fertilizer to irrigation water
- Requires irrigation install
- Accuracy depends on irrigation



# Discussion

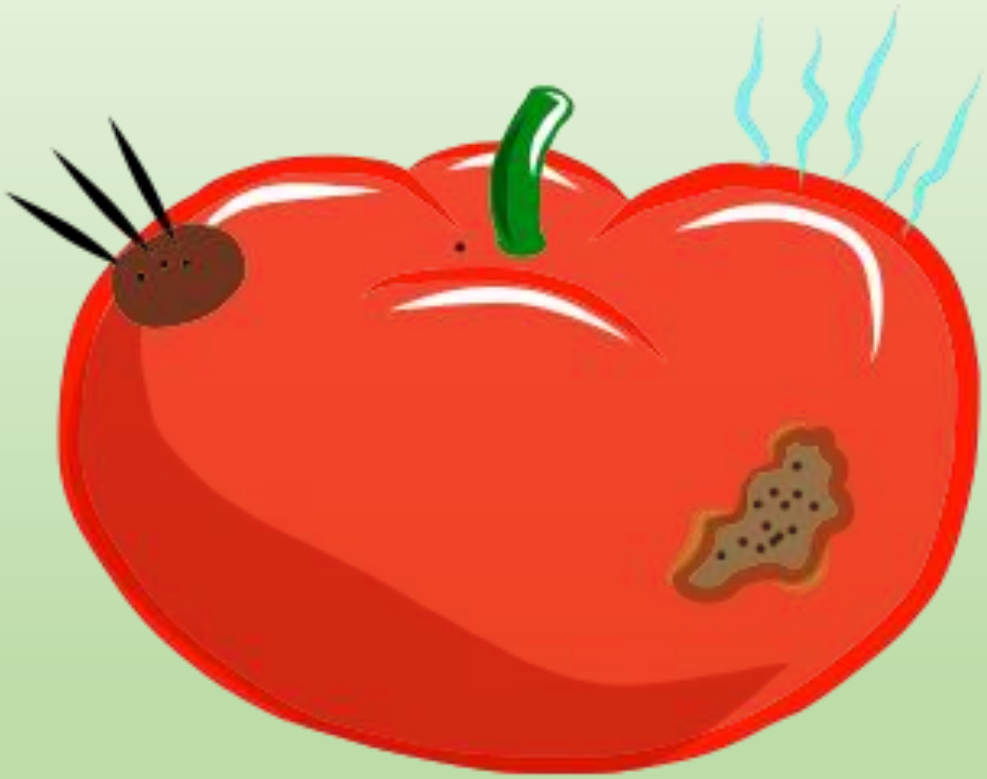
- What are your fertilizer sources?
- How much do you normally fertilize, how do you fertilize?
- Would you be likely to use this fertilizer schedule?
- Would you rotate beans for nitrogen fixing?
- Do you have anything to share with me?

# Harvesting and Handling of Vegetables

- Maintain Quality
- Protect food safety
- Reduce losses between harvest and consumption

# Causes of loss

- Water loss
- Bruising
- Decay
- Over ripeness



# Potential Storage life

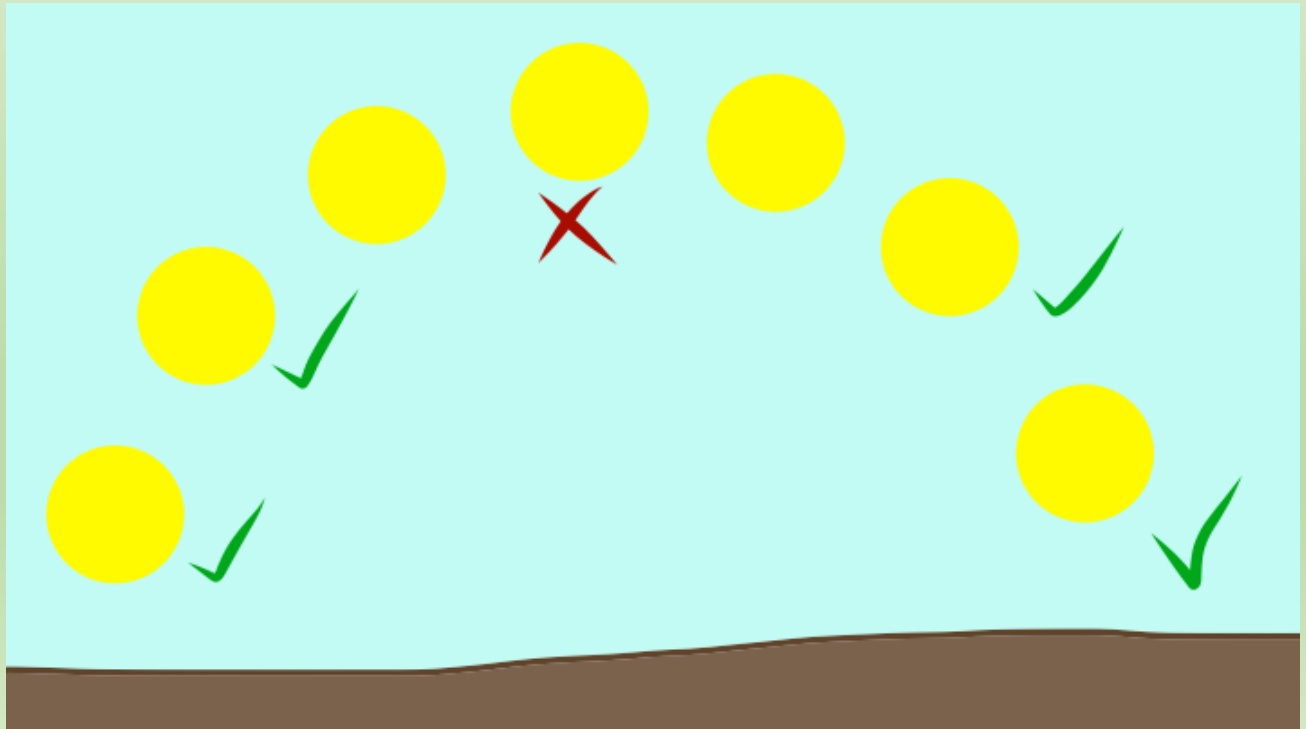
- Nightshade and tomato-less than 2 weeks
- Eggplant- 2 to 4 weeks
- Under optimum temperature and humidity

# When to Harvest

| When to Harvest | 'Tanya' Tomato | African Eggplant | African Nightshade |
|---|---|---|---|
| **Days to harvest from transplanting** | 60-80 | 60-90 | 40-60 for leaves |
| **Maturity indexes** | For unripe- Oblong in shape, flesh is hard, yellowish at top of fruit<br><br>For Ripe- 50% to 100% red | For unripe- Yellowish, light green to green<br><br>For ripe- orange to red | Shoots and leaves are mature. Plant should not be flowering.<br><br>For fruits- Black, hard fleshed fruit |

# Harvesting Techniques

- All vegetables should be harvested in the morning or evening
- Not during full sun
- Rainy days are good for harvesting too



- Tomato
- Can be harvested every day to two days once maturity occurs
- Short harvest season
- Pulled from plant or cut

- Eggplant
- Harvested every two weeks for up to 7 months
- Eggplants continue to produce
- Cut with a clean blade

- Nightshade
- Harvested every week for 6-8 weeks
- Main shoots and side shoots can be cut or pinched by hand
- Leave at least 5 cm of stem for plants to regrow
- Immediately place in cool water

# Factors affecting deterioration

- Vegetables begin to deteriorate immediately after harvest or maturity
- The fruit breathes through pores or wounds and causes water loss
- Immediately becomes more susceptible to decay

# Environmental factors

- Temperature
- Fruits deteriorate faster at higher temperatures
- Water loss is greater, activity in the fruit is faster

- Humidity
- More is good for lengthening storage time
- Moisture in the air slows water loss
- Must keep fruits dry though, or decay can occur faster

- Sunlight
- Promotes activity inside the fruit
- Shortens fruit storage life
- Keep all vegetables out of the sun

- Sanitation
- Dirty harvesting equipment and storage environment can promote disease and decay
- Cleaning out debris and sanitizing surfaces and equipment is important

# Handling after Harvest

- Harvested crop should be immediately moved into shade

- Dumping and cleaning

- Dump produce into a clean bin filled with clean water
- Reduces damage and cleans fruit
- Can sanitize with chlorine

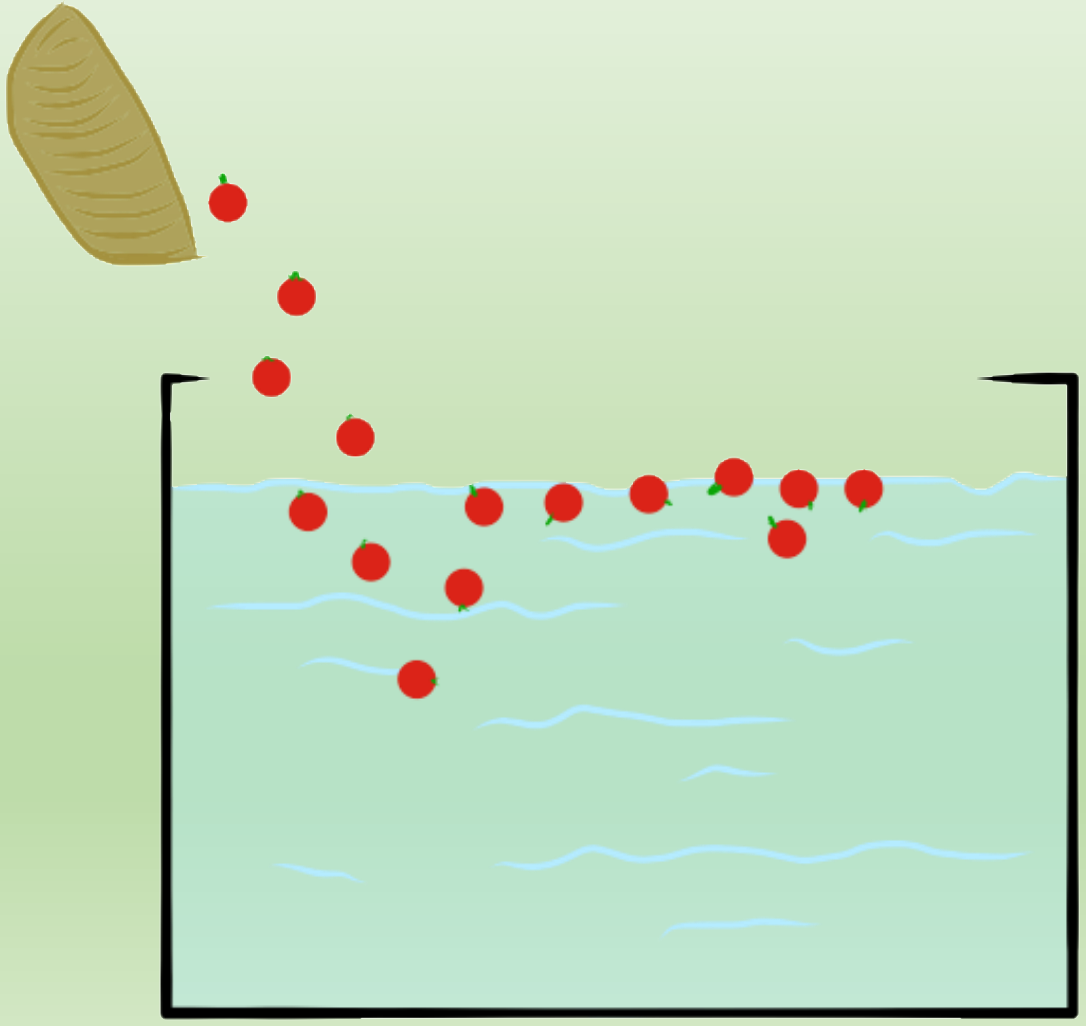


Photo credit-CTAHR news

- Sorting

- Vegetables need to be sorted for damaged and bad vegetables
- Sizing is optional
- Dry fruits of wash water

- Packing

- Can use reusable bins, or cardboard boxes
- Bags are not good because produce can be easily damaged

# Storage

- Store indoors
- Keep safe from livestock and rodents
- Storage environment should be clean
- Store off the ground
- Lower temperature and raise humidity

- Keep safe from livestock and rodents

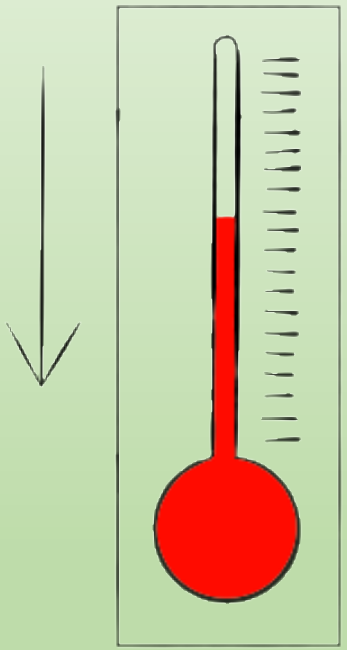

Photo credit- JB Friday

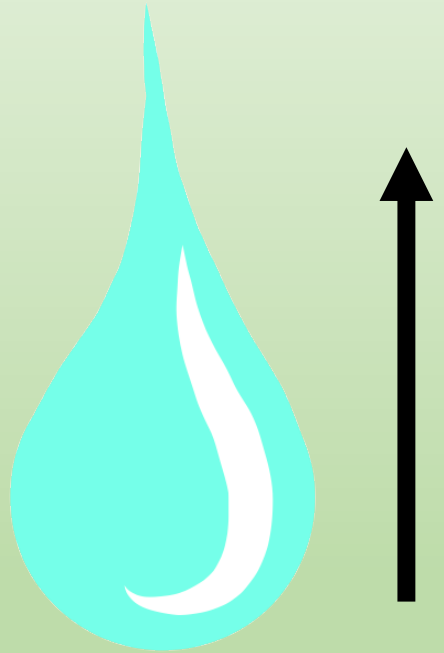
- Storage environment should be clean

Photo credit – Roshan Paudel

- Store off the ground

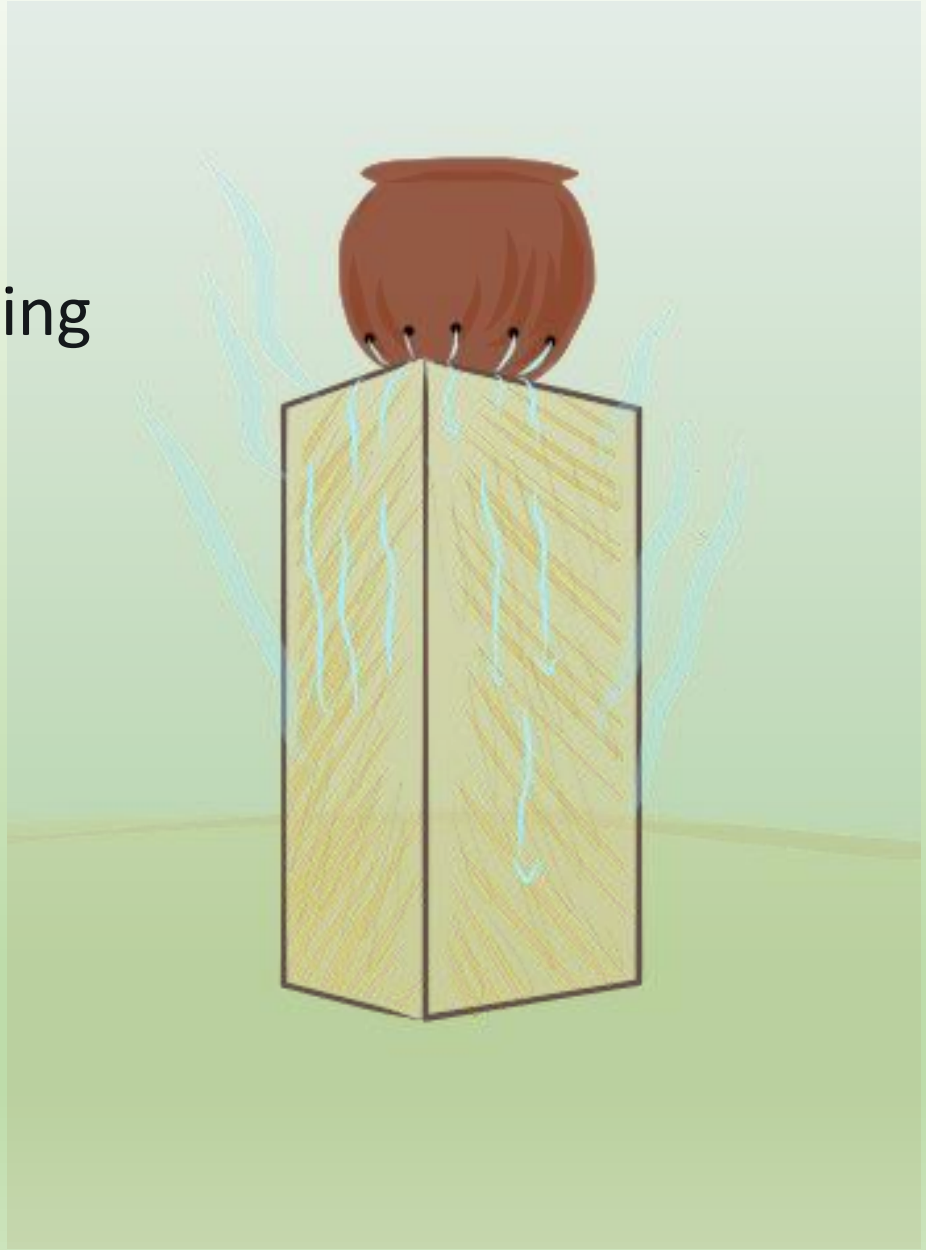
- Lower temperature and raise humidity





# Storage technologies

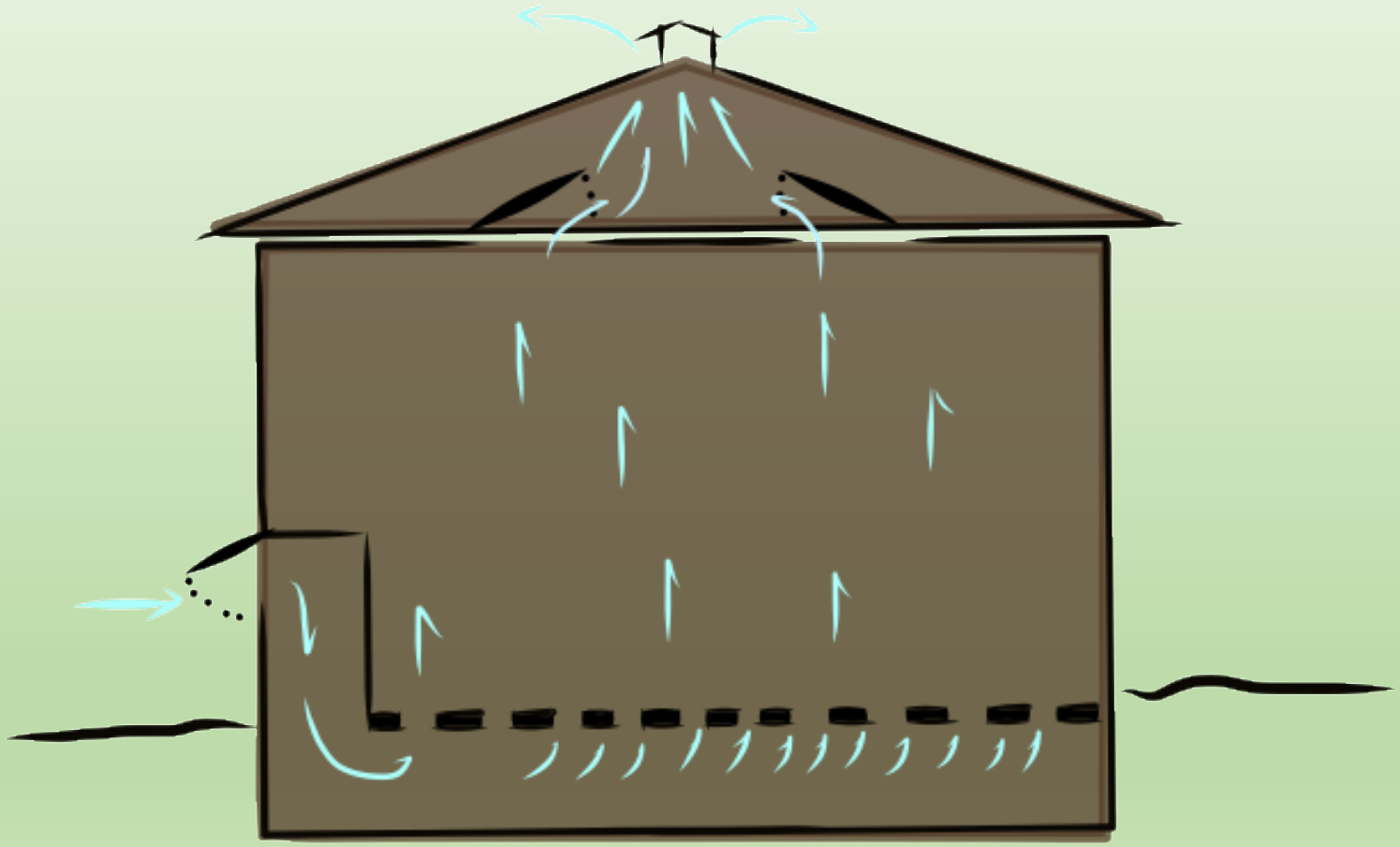
- Straw storage houses and evaporative cooling
- Straw walls and ceilings
- Moisten straw
- Will lower temperature and raise humidity



- Storage houses with living roof
- Build storage house directly under tree canopy
- Tree causes lower temperatures
- Use netting for roof

- Ventilation
- Airflow is important to reduce decay
- Can ventilate at night when air is cooler

- Build storage with ventilation from the ground to reduce air temperatures during the day



- High Altitude storage
- If it is feasible, transporting vegetables to higher altitudes and storing there will increase storage time

# Discussion

- How quickly do sell vegetables after harvest?
- How do you store your vegetables?
- What building materials do you have access to?
- Do you have access to electric fans or coolers?
- How feasible is washing and sterilizing your vegetables?
- Do you have anything you want to share with me?

# Thank you!

## Final Discussion

# References


- AVRDC. 1990. Vegetable production training manual. Asian Vegetable Research and Development Center. AVRDC Publication No. 90-328. Shanhua, Tainan.
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