HASS AVOCADOS

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INTRODUCTION

The Hass avocado is a popular variety known for its rich, creamy flavor and characteristic dark, bumpy skin that turns almost black when ripe.

It's named after Rudolph Hass, who bred the tree in the 1920s in California.

The Hass avocado is a globally dominant variety, particularly in North America and Europe, and is prized for its longer shelf life and suitability for various culinary applications.

Nutritional Benefits

- Assist in absorption of antioxidants
- Help prevent and treat cancer
- Reduce your risk of heart disease
- May boost brain health and memory
- May aid in weight loss
- Help prevent neurodegenerative diseases, such as Alzheimer's and Parkinson's.

- Help ease osteoarthritis
- Can combat metabolic syndrome
- Can help reduce liver damage

TYPES OF HASS AVOCADOES

All the other types of Hass avocados are all hybrids of the original Hass avocado that had been patented in 1935

Variations occur as a result of using grafting and slight regional differences: Soil type,climate,rootstock.

Genetically the same but may differ slightly in: Size, skin color/texture, oil content and yield timing.

Types:

- Original Hass
- Lamb Hass
- GEM
- Carmen Hass
- Maluma Hass
- Mendez No.1

Name	Type	Hybrid status	Origin/ Parentage	Notes/ References
ORIGINAL HASS	Cultiva	No	Seedling of unknown origin (likely Mexican × Guatemalan)	First patented 1935, global standard [UCR; CRFG]
LAMB HASS	Cultiva	Yes(Hass x Gwen)	California (1990s)	Larger fruit, later harvest [UCR Avocado Breeding Program]
GEM	Cultiva	Yes(Gwen derivative)	UC Riverside (Gwen × Thille	High yield, thick skin, export-ready [UCR, Cal Avocado Commission]
CARMEN	Spot(Genetic mutation)	No	Discovered in Spain	Flowers twice per year; earlier harvest [Eurosemillas]
MALUMA	Spontaneous selection	Possibly not a hybrid	South Africa	Compact growth, large fruit [SAAGA, Eurosemillas]
MENDEZ NO.1	Early-season variant	Possibly	Mexico	Early harvest, favored for export [Michoacán Exporters]

References:

UC Riverside Avocado Breeding Program
 https://plantscience.ucr.edu/avocado-breeding-program

California Rare Fruit Growers (CRFG): Hass & Pinkerton Profiles

- Hass: https://crfg.org/home/library/fruitfacts/avocado/
- Pinkerton: https://crfg.org/home/library/fruitfacts/pinkerton-avocado/

California Avocado Commission – Cultivar Info
 https://www.californiaavocadogrowers.com

South African Avocado Growers' Association (SAAGA) – Maluma Hass
 https://www.malumaavocado.com

Eurosemillas (Spain) – Carmen Hass
 https://eurosemillas.com/en/varieties/carmen-hass

Farmers Trend Kenya – Misused Terms like "Golden Hass"
 https://farmerstrend.co.ke

DISEASES AFFECTING HASS AVOCADOS, SYMPTOMS AND CURES

Hass avocados are affected by **a range of diseases**, primarily caused by **fungi**, **bacteria**, **viruses**, and **physiological disorders**.

Disease	Pathogen / Cause	Symptoms	Effect on Hass	Reference
Phytophthora Root Rot	*Phytophthora cinnamomi* (fungus-like oomycete)	Root decay, canopy dieback, leaf drop, stunted growth	Most destructive avocado disease worldwide	Ploetz et al. (2002); UC ANR
Anthracnose	*Colletotrichum gloeosporioides*	Dark sunken lesions on fruit, fruit rot post-harvest	Major postharvest issue	Prusky et al. (2009); UC IPM
Cankers / Dothiorella Rot	*Botryosphaeria spp.*, esp. *Lasiodiplodia theobromae*	Cankers on stems, fruit rot with stem-end black lesions	Common in hot, humid or poorly pruned orchards	Eskalen et al. (2013); UC Riverside
Verticillium Wilt	*Verticillium dahliae*	Wilting, leaf scorch, vascular browning	Usually infects trees planted after susceptible crops (e.g., tomatoes)	UC IPM; Ploetz (2007)
Sunblotch Viroid	Avocado Sunblotch Viroid (ASBVd)	Yellow streaks on stems, deformed fruit, low yield	Transmitted by grafting or infected seeds; no cure	FAO; Cal Avocado Commission

Scab	*Sphaceloma perseae*	Raised brown spots on fruit and leaves	Cosmetic damage, common in humid regions	Ploetz (2003); UC IPM
Powdery Mildew	*Oidium* spp.	White fungal growth on leaves, especially in nurseries	Usually mild but can affect young trees	UC ANR
Armillaria Root Rot	*Armillaria mellea*	Mushroom-like fungus at base, decay of root collar	Affects older orchards, no chemical cure	UC ANR; Ploetz et al. (2002)
Algal Leaf Spot	*Cephaleuros virescens* (alga)	Rusty or green patches on leaves	Common in humid areas, cosmetic	Ploetz (2003)

References:

Ploetz, R.C. (2003, 2007, 2010). *Diseases of Tropical Fruit Crops*, CABI Publishing.

● Covers comprehensive avocado disease management.

University of California Integrated Pest Management (UC IPM) – Avocado Pest Management Guidelines: http://ipm.ucanr.edu/PMG/selectnewpest.avocado.html

UC Riverside Avocado Disease Research (Dr. Akif Eskalen Lab): https://eskalenlab.ucr.edu/

● Research on Dothiorella, Phytophthora, and trunk disease complexes

California Avocado Commission – Grower Resources:
https://www.californiaavocadogrowers.com/growing/

- Disease ID, prevention, and orchard health guides

Food and Agriculture Organization (FAO) – Avocado diseases global summary:
http://www.fao.org/3/y4358e/y4358e0e.htm

Prusky, D. et al. (2009). "Colletotrichum gloeosporioides infection strategies in avocado." *Phytopathology*, 99(12): 1346–1352.
https://doi.org/10.1094/PHYTO-99-12-1346

Emerging Threats

- **Fusarium Dieback** caused by *Fusarium euwallaceae*, spread by ambrosia beetles (Euwallacea spp.)
- Part of a **complex disease** known as **Shot Hole Borer-Fusarium Complex** – destructive and spreading in California

Reference:

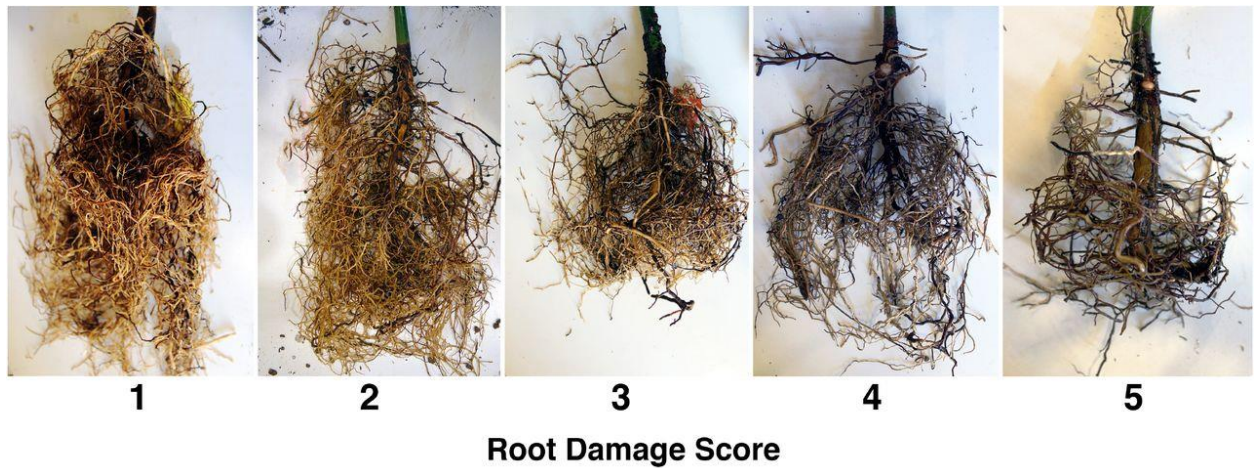UC Riverside Fusarium Dieback Page: https://ucanr.edu/sites/pshb/

CURES CONTROL AND MANAGEMENT

1. Phytophthora Root Rot

Root Damage Score

- **Cause:** *Phytophthora cinnamomi*, a soil-borne fungus.

a) **Excess Moisture:** Soil saturation or waterlogging creates favorable conditions for the growth and spread of *Phytophthora cinnamomi*. Excess moisture restricts oxygen availability to the roots, weakening the tree's defense against the pathogen.

b) **Infected Plant Material:** The fungus can persist in the soil for extended periods, even in the absence of avocado trees. Planting avocado trees in soil previously infested with *Phytophthora cinnamomi* increases the risk of root rot development.

c) **Poor Drainage:** Soils with inadequate drainage prevent water from escaping, increasing the likelihood of waterlogged conditions that promote the growth of the pathogen.

d) **High Soil Salinity:** Saline soils can exacerbate avocado root rot by further stressing the trees and reducing their ability to withstand the disease.

- **Symptoms:** Yellowing leaves, wilting, dieback, and reduced fruit yield.

a) **Wilting:** Affected avocado trees exhibit progressive wilting, especially during hot weather. The leaves may droop and curl, and the canopy may thin out as the disease advances.

b) Yellowing Leaves: Leaves may display a yellow or bronze discoloration, starting from the leaf margins and moving inward towards the midrib.

c) Reduced Growth and Productivity: Avocado trees suffering from root rot often exhibit stunted growth, reduced fruit production, and smaller-sized fruit.

d) Discolored Root System: The root system of infected trees may show signs of decay, turning dark brown or black, and becoming brittle. In advanced cases, root rot can lead to root death.

- **Treatment:**

  - **Chemical:** Apply phosphonate fungicides (e.g., phosphorous acid) via trunk injection or foliar sprays. Timing is crucial; apply in autumn after the summer leaf flush has hardened .
  - **Cultural:** Ensure proper drainage, avoid overwatering, use disease-free nursery stock, and consider planting on raised beds to reduce infection risk

- **Control and Management**

  a) Site Selection: Choose well-draining soils with good aeration for planting avocado trees. Avoid planting in areas with a history of root rot infections.

  b) Proper Irrigation: Implement a controlled and efficient irrigation system to prevent waterlogging. Avoid overwatering and monitor soil moisture levels regularly.

  c) Soil Improvement: Incorporate organic matter into the soil to improve its structure and drainage. This can enhance the tree's resistance to root rot.

  d) Disease-Free Planting Material: Source avocado trees from reputable nurseries that provide disease-free planting material.

e) Fungicides: In areas with a history of root rot, the application of fungicides may help protect the root system. Consult with agricultural experts to determine the appropriate fungicides and application timings.

f) Root System Inspections: Periodically inspect the root system of avocado trees for signs of disease. Promptly remove and destroy any infected trees to prevent the spread of the pathogen.

g) Quarantine Measures: Implement quarantine measures to prevent the movement of infected soil or planting material from one area to another.

Effective root rot control methods:

- disease free nursery trees
- using more tolerant rootstocks
- good drainage which includes the use of tree mounds
- mulching and good soil health
- appropriate soil moisture management
- chemical treatment
- good nutritional practices including sufficient calcium
- suitable soil pH.

2. Anthracnose or Black Spot

- **Cause:** *Colletotrichum gloeosporioides*, a fungal pathogen.

a) Environmental Conditions: Warm and humid weather is highly conducive to Anthracnose development. The pathogen thrives in moist conditions, and rain or irrigation can create an environment suitable for spore germination and infection.

b) Infection through Wounds: The pathogen gains entry into avocado tissues through wounds, such as those caused by insect feeding, hail damage, or improper pruning practices.

c) Poor Orchard Sanitation: Infected plant debris, fallen leaves, and infected fruit left on the ground can serve as sources of spores, leading to disease spread in subsequent growing seasons.

d) Secondary Infections: The disease can also spread from infected fruits to healthy fruits through direct contact or by splashing water during rain or irrigation.

- **Symptoms:** Dark, sunken lesions on fruit, especially post-harvest; leaf spots and dieback.

a) Fruit: Small, dark, and sunken lesions initially appear on the fruit surface. Over time, these lesions enlarge, becoming circular or irregular in shape. The center of the lesions may develop a tan or grayish color, surrounded by a dark border, giving it the characteristic "black spot" appearance. As the disease progresses, the fruit may decay, leading to significant yield losses.

b) Leaves: Anthracnose lesions on leaves are usually small and circular with dark centers and light-colored borders. Severely infected leaves may drop prematurely, leading to defoliation and reduced photosynthetic capacity.

c) Twigs and Stems: Infections on twigs and stems are less common but may occur under severe disease pressure. Symptoms include small, dark lesions that can cause dieback in young shoots.

- **Treatment:**

  - **Chemical:** Regular applications of copper-based fungicides during the growing season.

  - **Cultural:** Prune trees to improve air circulation, remove and destroy infected plant debris, and avoid overhead irrigation

- **Control and Management:**

a) **Pruning and Sanitation:** Regularly prune avocado trees to improve air circulation and sunlight penetration within the canopy. Remove and destroy any infected plant debris, fallen leaves, and infected fruit to reduce sources of spores.

b) **Fungicides:** Fungicides can be used as a preventive measure or curatively when disease pressure is high. Copper-based fungicides and synthetic fungicides with proven efficacy against Anthracnose can be applied following label instructions.

c) Irrigation Management: Avoid overhead irrigation, as wetting the foliage can facilitate disease spread. Use drip irrigation to deliver water directly to the root zone, minimizing leaf wetness.

d) Disease-Resistant Cultivars: When possible, select avocado cultivars that have demonstrated resistance or tolerance to Anthracnose, reducing the risk of infection.

e) Biological Control: Beneficial microorganisms, such as Trichoderma spp., can help suppress Anthracnose development. Commercial biological products can be applied to avocado trees to enhance disease resistance.

f) Harvest and Post-Harvest Practices: Handle harvested fruit with care to minimize mechanical injuries that can serve as inflection points. Implement proper post-harvest storage and handling practices to reduce disease spread during transportation and storage.

g) Monitoring: Regularly monitor avocado orchards for Anthracnose symptoms. Early detection allows for prompt action and minimizes disease spread.

3. Avocado Scab

- **Cause:** *Sphaceloma perseae*, a fungal pathogen.

	a) Environmental Conditions: High humidity, frequent rain, and prolonged periods of leaf wetness create favorable conditions for the fungal spores to germinate and infect avocado tissues.

	b) Cultivar Susceptibility: Some avocado cultivars are more susceptible to scab than others. For instance, the Hass variety is known to be particularly vulnerable to the disease.

	c) Pruning and Wounding: Pruning or any form of wounding on avocado trees can provide entry points for the pathogen, facilitating its penetration into the plant tissues.

	d) Infected Plant Debris: The fungus can survive on infected plant debris, fallen leaves, and fruit, acting as a source of infection for subsequent growing seasons

- **Symptoms:**Scab symptoms on avocados present as oval to round, raised areas of corky scab. The first lesions that appear are generally black/brown and scattered across the fruit's skin. The lesions begin to coalesce and merge, potentially affecting almost the entirety of the fruit.

    a) Fruit: Scab lesions on avocado fruit are the most visually noticeable symptoms. Initially, small, dark, raised spots appear on the fruit surface. As the disease progresses, these spots coalesce, forming larger, scaly, and corky lesions. Severe infections can lead to deformities and cracking of the fruit, rendering it unmarketable.

    b) Leaves: On avocado leaves, scab lesions are usually small, circular, and raised, with a dark brown to black appearance. As the lesions grow, they develop a characteristic corky texture.

    c) Stems and Branches: Scab lesions on stems and branches are similar to those on leaves, appearing as raised, dark brown spots.

- **Treatment:**

    - **Chemical:** Apply copper-based fungicides when flower buds appear and repeat every 3–4 weeks.

    - **Cultural:** Prune and destroy infected plant parts and manage thrips populations, as they can spread the disease.

- **Control and Management:**

    a) Disease-Resistant Cultivars: Whenever possible, choose avocado cultivars that have demonstrated resistance to scab. This will significantly reduce the likelihood of infection and decrease the disease's impact on the orchard.

    b) Sanitation: Practice good orchard sanitation by removing and destroying any infected plant debris, fallen leaves, and affected fruit. This

helps eliminate potential sources of spores and reduces the chances of disease spread.

c) Pruning Practices: Be cautious when pruning avocado trees, as wounds provide entry points for the fungus. Prune during dry periods, and use clean, sterilized tools to minimize the risk of introducing infections.

d) Fungicides: In severe cases or when the disease pressure is high, fungicides can be used as a preventive or curative measure. Consult with agricultural experts to determine the most appropriate fungicides and application timings for effective control.

e) Irrigation Management: Avoid overhead irrigation, especially during periods of high humidity, as this can promote the spread of the disease. Instead, use drip irrigation to deliver water directly to the root zone.

f) Monitoring and Early Detection: Regularly inspect avocado trees for any signs of scab lesions. Early detection allows for prompt intervention and prevents the disease from escalating.

4. Cercospora Spot

- **Cause:** *Pseudocercospora purpurea*, a fungal pathogen.

- **Symptoms:** Small, light-yellow spots on leaves and fruit that turn brown and may crack.

  Fruit: Small, irregular brown spots that may become sunken and develop cracks, compromising fruit quality.

  Leaves: Angular brown spots with yellow halos, leading to defoliation in severe cases.

  Stems: Lesions similar to those on leaves, potentially leading to twig dieback

- **Treatment:**

  - **Chemical:** Use copper-based fungicides during pre-flowering, fruit formation, and post-harvest stages.
  - **Cultural:** Remove and destroy infected plant debris and maintain proper tree spacing for air circulation .

5. Sunblotch

- **Cause:** Avocado sunblotch viroid.

- **Symptoms:** Yellow or white streaks on leaves and fruit, cracked bark, and stunted growth.

a) Yellow Streaking: The most common and characteristic symptom of Avocado Sunblotch is yellow streaking on the leaves. These streaks can be intermittent or continuous and may appear as wavy lines or bands of varying widths.

b) Leaf Deformities: Infected leaves may also exhibit distorted growth, curling, and narrowing, leading to a puckered or "wavy" appearance.

c) Reduced Fruit Quality and Yield: Severe infections can adversely affect fruit development and quality, leading to reduced yields and smaller, misshapen fruit.

d) Viroid Accumulation: Infected trees can accumulate the viroid in various parts, such as the leaves, stems, roots, and fruit

● **Detection and Diagnosis***:*

Detecting ASBVd in avocado trees requires specialized molecular techniques like **reverse transcription-polymerase chain reaction (RT-PCR) or real-time quantitative PCR (qPCR**). These methods can detect and quantify the presence of the viroid, even in asymptomatic trees.

● **Treatment:**

○ **Prevention:** Use certified disease-free planting material and sanitize tools to prevent spread, as there is no cure once a tree is infected .

● **Control and Management:**

a) **Certified Planting Material:** Obtain avocado planting material from reputable nurseries that follow rigorous viroid testing protocols to ensure the production of disease-free trees.

b) **Testing and Removal:** Regularly test trees for ASBVd and promptly remove any infected trees from the orchard to prevent further spread.

c) Sanitation: Practice good sanitation, ensuring that all pruning tools and equipment are properly cleaned and disinfected before and after use.

d) Quarantine and Regulation: Implement quarantine measures to prevent the movement of infected planting material to new areas and adhere to regulations for avocado propagation.

6. Bacterial Soft Rot
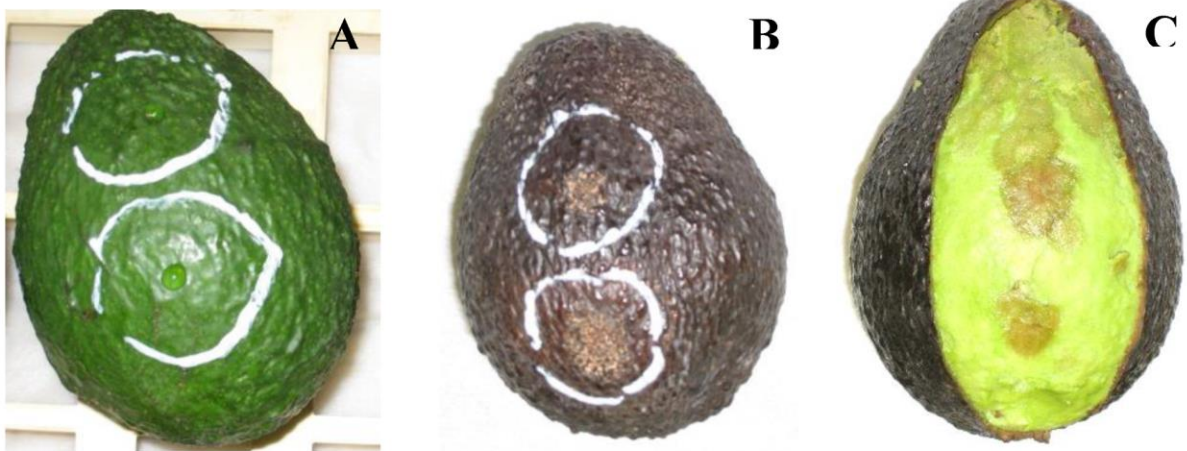
- **Cause:** Bacterial infection.

- **Symptoms:** Gray to black, mushy, foul-smelling rot on fruit.

- **Treatment:**

  - **No treatment is currently available.**
  - **Prevention:** Use certified disease-free seedlings and maintain good sanitation practices, as there is no known treatment

Integrated Disease Management Tips

- **Regular Monitoring:** Inspect trees frequently for early signs of disease.
- **Sanitation:** Remove and destroy fallen leaves, fruit, and pruned branches.
- **Pruning:** Maintain an open canopy to enhance air circulation.
- **Irrigation:** Avoid overwatering and ensure proper drainage.
- **Fertilization:** Apply balanced fertilizers to maintain tree vigor.
- **Resistant Varieties:** When possible, plant disease-resistant avocado cultivars.

References:

[Business Queensland – Avocado Health](#)

[UC IPM – Avocado Anthracnose](#)

[Farmers Trend – Avocado Diseases](#)

For visuals on fruit abnormalities check :

BEST PLANTING PRACTICES.

1. Site Selection & Climate

- **Altitude:** Ideal between **1,000–2,000 meters** above sea level.

- **Temperature:** Optimal range is **20°C to 24°C**.

- **Rainfall:** Requires **1,000–1,600 mm** annually, well-distributed.

- **Soil:** Prefers **well-drained loamy or sandy loam soils** with a pH of **5.5–6.5**.

- **Wind Protection:** Implement windbreaks, as strong winds can damage branches and cause fruit drop.

References:

[safiorganics.co.ke](#)

[organicfarm.co.ke](#)

[victormatara.com](#)

[farmerstrend.co.ke](#)

Regions like Kiambu, Murang'a, Nyeri, Kisii, and Meru are particularly suitable for Hass avocado cultivation. (victormatara.com)

2. Land Preparation

- **Clearing:** Remove weeds, rocks, and debris.

- **Ploughing:** Till the land to a depth of about 30 cm to improve soil aeration and drainage.

- **Soil Testing:** Conduct tests to determine pH and nutrient levels, allowing for appropriate amendments.

    References:

    farmerstrend.co.ke

    zaozetu.co.ke

3. Planting Guidelines

- **Seedlings:** Use **grafted Hass avocado seedlings** from certified nurseries to ensure disease resistance and early fruiting.

- **Hole Preparation:** Dig holes measuring **60 cm x 60 cm x 60 cm**. Separate topsoil from subsoil.

- **Soil Enrichment:** Mix topsoil with **20 kg of well-decomposed manure** and **250 g of double superphosphate fertilizer**.

- **Planting Time:** Plant at the onset of the rainy season to ensure adequate moisture for establishment.

- **Spacing:** Maintain a spacing of **5 m x 5 m**, accommodating approximately **150 trees per acre**.

References:

zaozetu.co.ke

freshelaexporters.com

victormatara.com

organicfarm.co.ke

4. Irrigation

- **Young Trees:** Require regular watering, approximately **25 mm per week**.

- **Irrigation Methods:** Drip or micro-sprinkler systems are recommended to provide consistent moisture without waterlogging.

- **Water Quality:** Ensure irrigation water has low salinity to prevent root damage.

References:

tujue.co.ke

seedfarm.co.ke

5. Mulching

- **Purpose:** Retains soil moisture, regulates temperature, and suppresses weeds.

- **Materials:** Use organic mulches like straw, grass clippings, or compost.

- **Application:** Apply mulch around the base of the tree, keeping it a few centimeters away from the trunk to prevent rot.

References:

zaozetu.co.ke

6. Pruning and Thinning

- **Pruning:** Conduct before flowering and after harvesting to remove dead or diseased branches and to shape the tree for better light penetration.

- **Thinning:** Remove excess fruits to reduce competition for nutrients, resulting in larger, marketable fruits.

    References:

    zaozetu.co.ke

    safiorganics.co.ke

7. Fertilization

- **Organic Fertilizers:** Apply well-decomposed manure or compost twice a year, preferably during the onset of rains.

- **Inorganic Fertilizers:** Use NPK fertilizers (e.g., 17:17:17) at a rate of **200 g per tree per year**, split into two applications.

- **Soil Testing:** Regular tests help tailor fertilization to the specific nutrient needs of your orchard.

    References:

freshelaexporters.com

farmerstrend.co.ke

8. Pest and Disease Management

- **Common Pests:** Thrips, fruit flies, and scale insects.

- **Common Diseases:** Root rot, anthracnose, and Cercospora spot.

- **Control Measures:** Implement integrated pest management practices, including regular monitoring, use of organic pesticides, and maintaining orchard hygiene.

  References:

  victormatara.com

  zaozetu.co.ke

9. Pollination

- **Self-Pollination:** Hass avocados are self-pollinating but benefit from cross-pollination.

- **Companion Planting:** Planting varieties like Fuerte nearby can enhance fruit set.

- **Bee Integration:** Introducing beehives can improve pollination efficiency.

  References:

  freshelaexporters.com

10. Harvesting

- **Maturity Period:** Trees begin to bear fruit **3–4 years** after planting.

- **Yield:** A mature tree can produce **200–500 fruits** annually, with yields increasing as the tree ages.

- **Harvesting Time:** In Kenya, the main harvesting season spans **February to June**, varying slightly by region.

    References:

    victormatara.com

    tuko.co.ke

For a visual representation and further details, you might find this resource helpful:

Best Practices for Hass Avocado Farming in Kenya

Knowledge Base Requirements for an AI-Based Camera Model

Here's what you'll need to develop an avocado disease diagnosis model using AI and cameras:

A. Image Dataset Requirements

- **Images Needed:**
    - Healthy vs. diseased **leaves, fruit, bark, stems**
    - Multiple angles and lighting conditions

- **Labeling Style:**
    - Classification: "healthy," "Anthracnose," etc.
    - Object Detection: bounding boxes around affected areas

- **Image Resolution:**
    - Minimum: 640×480px
    - Ideal: ≥1080p for spotting small lesions

B. Annotation Tools

- [LabelImg](#)
- [Roboflow](#)
- [CVAT](#)

C. AI Model Architecture

- **Base Models**:
  - MobileNetV2 (lightweight, edge-friendly)
  - ResNet50 or EfficientNet (for higher accuracy)

- **Task Type**:
  - Image classification for early models
  - Object detection (YOLOv5/YOLOv8) for pinpointing exact disease areas

D. Training Frameworks

- TensorFlow or PyTorch
- Transfer learning recommended for small datasets

E. Hardware Setup for Real-Time Use

- **Field Device Options**:
  - Jetson Nano or Jetson Xavier
  - Raspberry Pi with HQ Camera Module
- **Environmental Sensors (Optional)**:
  - Humidity, temperature, soil moisture — useful for prediction models

Final Tip:

To improve accuracy, you can include **metadata** with each image:

- Crop age
- Location

- Weather at time of capture
- Stage of growth

How to Collect or Simulate an Image Dataset for Hass Avocado Disease Detection

1. Field Image Collection Plan

Step	What to Do
Identify Farms	Target avocado farms (preferably Hass) in different counties or altitudes
Choose Sample Trees	Select both healthy and diseased trees across different stages of growth
Use a Quality Camera	At least 1080p (smartphones with good cameras or a DSLR if available)
Lighting Conditions	Take images in daylight, cloudy, and shaded conditions for diversity
Target Areas	Photograph leaves (top/bottom), stems, bark, fruit – both close-up and full
Organize Files	Use folders like: `/anthracnose/`, `/root_rot/`, `/healthy/`, etc.

You'll want **100–300 images per class** to start training even a basic model.

2. Image Augmentation Techniques (For Simulation/Expansion)

Use libraries like **Albumentations** or **TensorFlow ImageDataGenerator** to simulate diversity:

- Rotation
- Flip (horizontal/vertical)
- Brightness/contrast shift
- Crop/zoom

This can **triple or quadruple** a small dataset and simulate different conditions.

3. Open Datasets You Can Use

If field data is not available yet, you can supplement from:

- PlantVillage Dataset (Penn State)
- Mendeley Data – Avocado Leaf Diseases
- Roboflow Public Datasets

Label the images yourself if they aren't pre-labeled.

Basic AI Model Outline for Detecting Avocado Diseases

Here's a simple workflow for a **classification model**, ideal as your first prototype:

1. Prepare Dataset

- Train/test/validation split: 70/20/10
- Organize folders:

```bash
/dataset/
  /train/
    /healthy/
    /anthracnose/
    /root_rot/
  /val/
  /test/
```

2. Build a CNN Model (Using TensorFlow/Keras

3. Model Evaluation

- Use `model.evaluate()` on the test set
- Look at confusion matrix to check misclassifications
- Save with: `model.save('avocado_disease_model.h5')`

4. Deploy on Camera Device (Later Stage)

When ready for real-time deployment:

- Convert model with **TensorFlow Lite**
- Use a **Jetson Nano** or **Raspberry Pi + camera** with OpenCV to capture live images
- Send images through the model and output diagnosis labels (healthy or disease type)