Crop Growing Guides for Home Production
Plants for multiple harvests of the leaves or growing shoots

Amaranth can adapt to most soil types

Seeds form on adult plants

Young plants ready for harvest

If young plants are harvested by uprooting, the plants can be grown closely together

Harvesting young plants in bundles

Plants for multiple harvests of the leaves or growing shoots

Preferred climactic conditions

<table>
<thead>
<tr>
<th>Air temperature</th>
<th>Wide range within tropical and subtropical regions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Soil type</td>
<td>Well-drained sandy loams, but can adapt to most soil types</td>
</tr>
<tr>
<td>Climate conditions</td>
<td>Hot-dry</td>
</tr>
<tr>
<td>Sun/shade tolerance</td>
<td>Full or partial sun</td>
</tr>
<tr>
<td>Drought tolerance</td>
<td>High</td>
</tr>
<tr>
<td>Flood tolerance</td>
<td>Low</td>
</tr>
</tbody>
</table>

Seed sowing and spacing

<table>
<thead>
<tr>
<th>Direct sowing</th>
<th>Seeds are very small, mix one part seed to ten parts sand for uniform stand. Sow into rows.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Seed depth</td>
<td>Cover seeds with light soil</td>
</tr>
<tr>
<td>Between-plant spacing</td>
<td>10-20 cm</td>
</tr>
<tr>
<td>Row spacing:</td>
<td>15-30 cm</td>
</tr>
</tbody>
</table>

Cultivation

Irrigation needs: Although amaranth is relatively drought tolerant, insufficient water will reduce yield. Gently irrigate after sowing to reduce seed displacement. Water to ensure good germination and prevent wilting.

Fertilizer: Start with a well-drained fertile soil. If leaves appear yellow, apply half of a mineral water bottle cap of inorganic nitrogen fertilizer around the base of each plant or use a liquid foliar fertilizer.

Special cultivation practices: Staggered sowing results in continuous harvesting and regular consumption. Divide a well-fertilized bed into three parts. Make shallow trenches 15–30 cm apart. Sow seed in the first part and cover with a thin layer of soil. Since seeds are very small, mix 10 parts fine, dry sand with 1 part seed before sowing to get uniform distribution along the row. After 7-10 days, sow in the second part and do similarly in the third part 7-10 days later. To encourage leaf production, remove seed heads when they form.

Harvesting

When to harvest: Amaranthus leaves are ready for harvest in 20-45 days after sowing depending on variety and planting time/season. Plant leaves may be harvested once or several times. For seed production, cut the entire seed head before visible shattering.

How to harvest:

If plants are to be harvested once, uproot plant, wash them, and tie them in bundles. Wash leaves with uncontaminated water after harvesting.

For multiple harvests, either clip off full-grown side leaves (roughly fifty percent of foliage or tender stem) or cut the top of the plant to encourage side branching and more leaves. Depending on the variety, 3-5 cuttings can be done by harvesting the top portion of the plant. Harvest in 10-15 day intervals. Eventually, the plants begin to flower and develop fewer leaves. After the last harvest, the plant could be allowed to flower and produce seed. For seed production, cut the entire panicle inflorescence at its base.
Amaranth pests

AMARANTH LEAF WEBBER / BEET WEBWORMS

Amaranth leaf webbers can cause up to 100% yield losses. They wrap and roll leaves to form shelters, feed by chewing between leaf veins (skeletonization of leaves), and leave behind brown frass deposits.

CONTROL
• Use pest-resistant varieties, biopesticides, blends of synthetic floral attractants and pheromones, and natural enemies (parasitoid wasps).

AMARANTH STEM WEEVIL

Larvae of the weevil forms galls in the stem and the adults feed on leaves and tender stems. This makes plants more susceptible to lodging and to secondary fungal infections.

CONTROL
• Collect and destroy wild amaranthus hosts in the vicinity of cultivated crop.
• Collect and destroy affected plant parts along with grubs and adults.
TWO-SPOTTED SPIDER MITE

Larvae, nymphs, and adults prefer to feed on plant sap from the underside the leaves, which causes white or yellow speckles. In severe infestations, they produce a spider web that covers the plants and forms a ball-like mass at the tip of the plant that can be carried by wind to new plants.

CONTROL
- Regularly spray plants with water to keep spider mites in check and remove and destroy infested plants.
- Release predators such as predatory mites, ladybugs, pirate bugs, six spotted thrips or green lacewings.

LEAF MINER FLIES

Female flies deposit their eggs within the leaf tissue so that the larvae or cylindrical maggots (soft body and no legs) feed inside the leaf tissue and cause irregular mines as they feed. Most larva cut an opening at the end of the mine and move to the soil for pupation. If several mines are formed in the same leaf, photosynthesis is reduced and the yield may be affected. If severe infestation occurred, the whole plant can die.

CONTROL
- Remove and destroy individual affected leaves.
- Yellow sticky traps may reduce the density of leaf miners and traps can also be used to monitor populations.
Cultivation

Irrigation needs: Although cowpea is relatively drought tolerant, insufficient water will reduce yield. Gently irrigate after sowing to reduce seed displacement and then water daily. Once beans have started to flower they become very sensitive to soil moisture deficit. Adequate irrigation at this time will reduce flower drop and increase yield.

Fertilizer: Start with a well-fertilized bed. Beans will benefit greatly from compost or manure if the soils are infertile.

Special cultivation practices:Beans should be grown on ridges as the plants are highly susceptible to water logging after heavy rains. Ridges are made by hoe or using oxen in two passes. The first pass is made when weeds are still small, and the second one month later to work up the ridges again. Two-stage preparation is advisable to avoid excessive incorporation of weeds as this will reduce yields.

Harvesting

LEAVES

When to harvest: For cowpea leaves, harvest leaves 30 days after planting.

How to harvest: For leaves, pluck leaves and stems off the plant as needed 10 cm above ground.

PODS

When to harvest: For cowpea pods, harvest pods at 40–50 days after planting for immature or green pods and at 55–70 days after planting for dry seeds or pods. Pods should be harvested all at once when 2/3 of the pods are dry and yellow. The pods do not mature at the same time because cowpea flowers have a staggered flowering period. Pods should be harvested when they turn from green to yellow/brown, but before they shatter.

How to harvest: For pods, green pods can be continuously harvested as long as the outline of the seed is visible on the pod. For dried pods, the whole plant should be pulled from the soil and left to dry when at least two-thirds of pods appear dry and yellow. When the pods are dry enough to split, place them into sacks, beat the sacks with a stick, and winnow off the chaff for seeds or peas.
Eggplant
(brinjal / aubergine)

<table>
<thead>
<tr>
<th>Preferred climactic conditions</th>
<th>Seed sowing and spacing</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Air temperature</strong></td>
<td>Hot temperatures up to 30°C</td>
</tr>
<tr>
<td><strong>Soil type</strong></td>
<td>Well-drained sandy loam to clay loams</td>
</tr>
<tr>
<td><strong>Climate conditions</strong></td>
<td>Hot-dry</td>
</tr>
<tr>
<td><strong>Sun/shade tolerance</strong></td>
<td>Full or partial sun</td>
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<td><strong>Drought tolerance</strong></td>
<td>Low</td>
</tr>
<tr>
<td><strong>Flood tolerance</strong></td>
<td>Low</td>
</tr>
<tr>
<td><strong>Direct seeding</strong></td>
<td>Plant 2-3 seeds per planting hole. Thin to one healthy seedling when plants have 4-5 leaves.</td>
</tr>
<tr>
<td><strong>Transplanting</strong></td>
<td>Sow one seed per container. Healthy seedlings can be transferred four to six weeks after sowing or when they have 4-5 leaves. One week before transplanting, harden off seedlings by gradually increasing exposure to full sunlight.</td>
</tr>
<tr>
<td><strong>Seed depth</strong></td>
<td>0.5-1 cm</td>
</tr>
<tr>
<td><strong>Between-plant spacing: 50 cm</strong></td>
<td></td>
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<tr>
<td><strong>Row spacing: 50 cm</strong></td>
<td></td>
</tr>
</tbody>
</table>

**Cultivation**

Irrigation needs: Eggplants are sensitive to drought conditions and will suffer yield losses from insufficient water. Gently irrigate after sowing to reduce seed displacement and then water daily. Once eggplants have started to flower they become very sensitive to soil moisture deficit. Adequate irrigation at this time will reduce flower drop and increase yield.

Fertilizer: Start with a well-fertilized bed. If leaves appear yellow, apply one bottle cap of inorganic nitrogen fertilizer around the base of each plant or use a liquid foliar fertilizer.

**Harvesting**

When to harvest: Fruits will start to ripen roughly **two months** after transplanting. Color of ripe fruits depends on the variety. Harvest fruits that are still tender and not woody or mushy.

How to harvest: Harvest ripe fruits by cutting a short piece of stem above the cap of the fruit using a sharp knife. Harvesting is done as fruits mature over the course of a few weeks to months. When harvesting, also remove all over-sized and damaged fruits to prolong the fruiting period of the crop. Harvest frequently to promote a heavier fruit yield. Protect fruits from the sun, rain, and mechanical damage after harvest. Old plants that are starting to dry off can be cut back at the base (ratooned) and young shoots will grow and produce fruits after 2-3 months.

**Flowering stage**
**Harvesting stage**
**Round purple eggplants**

**Long purple eggplants**
**Round white eggplants**
**Round green eggplants**
Eggplant pests

**APHIDS**

Nymphs and adults feed on plant sap and mainly settle on tender shoots and lower leaf surfaces. Aphids secrete honeydew on which sooty mold can grow, which in turn blocks the amount of sunlight needed for the leaves to photosynthesize and thus slows plant growth. Severe infestation causes stunting and leaf curling.

**CONTROL**
- Remove infested plants and release predators (e.g. ladybird beetle, hover flies, lacewings) to control aphid population.

**LEAFHOPPER**

Both nymphs and adults inject toxic saliva into plants during feeding, which causes yellow to brown lesions called hopper burn. High amounts of leafhoppers on the plants may reduce photosynthesis, which in turn may have a negative effect on fruit production.

**CONTROL**
- Use tolerant or resistant varieties with hairy leaves.
- Use yellow sticky traps or trap crops (e.g. okra) to control leafhoppers.

**SPOTTED BEETLES**

Grubs and adults scrape the chlorophyll from the epidermis, which results in a ladder-like window on leaves, flowers and fruits. Heavy infestations can completely destroy young plants.

**CONTROL**
- Manually collect eggs, grubs and adults and destroy.
- Release predators, such as spined soldier bugs, to control grubs.
EGGPLANT FRUIT AND SHOOT BORER

Larvae bore into plant parts to feed on flower buds, shoots and fruit and fill entry holes with excreta (frass). This insect mainly feeds on fruits. The damage leads to a delay of crop maturity.

CONTROL

• Remove the infested plant parts and release parasitoids (e.g. *Trathala flavoorbitalis*, *Trichogramma chilonis*)

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WHITEFLY

Nymphs and adults feed on plant sap and colonize undersides of the leaves. The damage causes plant vigor reduction and whitefly can also transmit eggplant yellow mosaic virus infection.

CONTROL

• Grow eggplant seedlings under insect-proof (50–64 mesh) net houses.
• Control whitefly population using plant barriers (maize, sorghum or pearl millet) and yellow or blue sticky traps.

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RED SPIDER MITE

Larvae, nymphs, and adults prefer to feed on plant sap from the underside the leaves, which causes white or yellow speckles. In severe infestations, they produce a spider web that covers the plants and forms a ball-like mass at the tip of the plant that can be carried by wind to new plants.

CONTROL

• Regularly spray plants with water to keep spider mites in check and remove and destroy infested plants.
• Release predators such as predatory mites, ladybugs, pirate bugs, six spotted thrips or green lacewings.

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THRIPS

Thrips attack a wide range of crops. Thrips mostly feed on foliage, but sometimes suck sap from fruits as well. Infested leaves have silvery feeding scars on the lower leaf surface, especially along the mid-rib and veins, where thrips have sucked the sap. If infestation is severe, leaves turn yellow or brown, and infested fruit is scarred and deformed.

CONTROL

• Grow eggplant seedlings in insect-proof (50–64 mesh) net houses, or plastic houses to avoid early infestation.
• Use blue sticky traps to monitor thrips and determine when other pest management is required.
• Use mulch and reflective material to reduce thrips incidence.
Kang kong
(water spinach / river spinach / swamp morning-glory / water morning glory / water convolvulus / Chinese spinach)

**Cultivation**

**Irrigation needs:** Kang kong is a semi-aquatic vegetable and requires lots of water during all growing stages. Irrigating twice a day is recommended in the dry season. Soil should be consistently muddy.

**Fertilizer:** Start with a well-fertilized bed. Apply a liquid foliar fertilizer if growth appears to lag.

**Special cultivation practices:** Kang kong can also be planted by cuttings. Trim cutting to approximately five to ten cm below a node and then place cutting in water with the base of the cutting submerged for about seven to ten days. At this point the cuttings can be planted directly. This can save the cost of buying the seeds.

**Harvesting**

**When to harvest:** The first cutting of leaves and succulent stems can be done within a month after sowing.

**How to harvest:** Harvest young shoots at 5-10 cm above ground level, taking care to leave nodes below the first cut. Multiple harvests can be done if secondary shoots are allowed to grow from these nodes. Do a shallow hoeing after the first harvest to promote further growth.

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**Preferred climactic conditions**

<table>
<thead>
<tr>
<th>Air temperature</th>
<th>Between 25-32°C</th>
</tr>
</thead>
<tbody>
<tr>
<td>Soil type</td>
<td>Loamy clay, but can adapt to different kinds of soil conditions</td>
</tr>
<tr>
<td>Climate conditions</td>
<td>Hot-wet</td>
</tr>
<tr>
<td>Sun/shade tolerance</td>
<td>Full sun</td>
</tr>
<tr>
<td>Drought tolerance</td>
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</tr>
<tr>
<td>Flood tolerance</td>
<td>High</td>
</tr>
</tbody>
</table>

**Seed sowing and spacing**

| Direct seeding | Soak seeds in water for 24 hours. Plant two to three seeds per planting hole. Thin to one healthy seedling when plants have 4-5 leaves. |
| Seed depth | 1 cm |
| Between-plant spacing: 15 cm | |
| Row spacing: 25 cm | |

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**Kang kong in containers**

**Kang kong in bottle containers**

**Kang kong on vegetable table**

**Flowering kang kong**

**Kang kong ready for harvesting**

**Harvested kang kong**
Malabar spinach
(vine spinach / red vine spinach / Ceylon spinach / Indian spinach)

Cultivation

Irrigation needs: Malabar spinach requires a regular supply of moisture since it is a shallow-rooted crop. The first five days of plant growth (germination and seedling emergence) are very moisture dependent as seeds can easily dry out. Malabar spinach requires constant moisture to prevent blossoming, which will turn leaves bitter, therefore water one to two times daily as needed.

Fertilizer: Start with a well-fertilized bed. If leaves appear yellow, apply half a bottle cap of inorganic nitrogen fertilizer around the base of each plant or use a liquid foliar fertilizer.

Special cultivation practices: When the seedlings have developed five true leaves, remove the growing tips to facilitate lateral shoot growth. Vines can be trellised if desired to take advantage of vertical garden space and wall surfaces. Malabar spinach cuttings can also be direct planted – trim cutting to about 15 cm and make sure to cut below a node for planting.

Harvesting

When to harvest: The young and tender tips and leaves can be first harvested when the plants reach 20–30 cm in height, roughly 30–45 days after planting, and can be continuously harvested every 2–5 days.

How to harvest: Prune young and tender tips and leaves every 2–5 days.

Preferred climactic conditions

<table>
<thead>
<tr>
<th><strong>Air temperature</strong></th>
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</tr>
</thead>
<tbody>
<tr>
<td><strong>Soil type</strong></td>
<td>Sandy loams, but can adapt to most soil types</td>
</tr>
<tr>
<td><strong>Climate conditions</strong></td>
<td>Hot-wet</td>
</tr>
<tr>
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</tr>
</thead>
<tbody>
<tr>
<td><strong>Seed depth</strong></td>
<td>1 cm</td>
</tr>
<tr>
<td><strong>Between-plant spacing: 30 cm</strong></td>
<td></td>
</tr>
<tr>
<td><strong>Row spacing: 30 cm</strong></td>
<td>🧮</td>
</tr>
</tbody>
</table>

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Full plant of green Malabar spinach with young shoots, flowers and seed settings
Malabar spinach container garden
Green Malabar spinach young shoot ready to harvest
Young plants ready for transplanting
Flowering Malabar spinach
Young shoot purple Malabar spinach ready to harvest

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HOME GARDENING GUIDE

Malabar spinach
(vine spinach / red vine spinach / Ceylon spinach / Indian spinach)

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# Moringa

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<th>Air temperature</th>
<th>Soil type</th>
<th>Climate conditions</th>
<th>Sun/shade tolerance</th>
<th>Drought tolerance</th>
<th>Flood tolerance</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Between 25–35°C</td>
<td>Well-drained sandy or loamy soils, but will tolerate clay soils with good drainage</td>
<td>Hot-dry</td>
<td>Full sun</td>
<td>High</td>
<td>Low</td>
</tr>
</tbody>
</table>

## Seed sowing and spacing

<table>
<thead>
<tr>
<th>Seed sowing and spacing</th>
<th>Direct seeding</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Soak the seeds overnight, crack and remove the shells. Plant only the kernels. Dig a planting pit 50 cm deep and wide and fill with compost. The day before seeding, water the pit. Sow 1–2 kernels per pit. Thin to one healthy plant per pit when seedlings reach 30 cm.</td>
</tr>
</tbody>
</table>

### Transplanting

For seedling production, 18 cm x 12 cm poly bags (thick plastic bags) should be filled with a mixture of three parts soil to one part sand. Soak seeds overnight, crack and remove the shells. Plant only the kernels. Seedlings can be transplanted into a compost-filled pit or garden when they are 60–90 cm high. The day before transplanting, water the pit or garden. Trees can also be established from hard wood cuttings (not green wood). The cuttings can planted in nursery sacks and transplanted after two to three months or planted directly in soil. For planting directly, cuttings that are 45 cm to 1.5 m long and 10 cm thick can be planted directly in light, sandy soil. Plant one-third of the cutting length in the ground. Do not over-water or the roots may rot.

## Seed depth

**Preferred climactic conditions**

<table>
<thead>
<tr>
<th>Seed depth</th>
<th>2 cm</th>
</tr>
</thead>
</table>

### Between-plant spacing: 3m

**If mature trees are desired, space pits 3 m x 3 m apart.**

**For intensive leaf harvesting**, space plantings 1.5 m x 1.5 m apart.

**For living fence posts**, space plantings 1 m apart in a line.

## Cultivation

### Irrigation needs:
Although moringa is relatively drought tolerant, insufficient water will reduce yield. Gently irrigate after sowing to reduce seed displacement. Water daily to support seedling growing.

### Fertilizer:
Start with a well-fertilized pit. Apply additional compost or well-rotted manure around the base of each plant 1–2 times per year to aid growth.

### Special cultivation practices:
As moringa seedlings grow, consistent pruning in the first three months will encourage bushy trees that produce many pods and leaves. To prune, when seedlings reach a height of 60 cm, pinch the terminal growing tip 10 cm from the top. Secondary branches will appear within one week. When these branches are 20 cm long, cut them back to 10 cm. Tertiary branches will appear and should be pinched in the same way. Always use a sharp knife to prune and make a slanting cut. Trees grown for leaf harvesting should be regularly pruned to maintain a height of 1–1.5 m. Moringa seedlings planted to make a living fence should be pruned when they reach 1–1.5 m. Moringa seeds have no dormancy period, so they can be planted as soon as they are mature and they will retain the ability to germinate for up to one year. Edible parts of the tree are the fresh leaves and the seed pods. Fresh leaves can be eaten as salad greens, cooked and combined with staples such as rice or wheat, or pickled and added to curries and soups. Dried leaves can be stripped from the tough stems and rubbed into a powder to add to soups or porridge. Young pods can be boiled, steamed, fried or shelled. Immature seeds can be eaten like peas or fresh beans. Mature seeds can be fried or roasted. Fresh or dried flowers can be used for making teas.

## Harvesting

### When to harvest:
Leaves can be harvested when plants grow to 1.5 m tall, roughly one year after planting. Harvest pods when they are young, tender and green. Young pods will be about 1 cm in diameter. Older pods are fibrous and develop a tough shell, but their pulp and immature seeds remain edible until shortly before the ripening process begins.

### How to harvest:
Harvest leaves by snapping leaf stems from branches. Harvesting young shoot tips will promote growth of side branches.

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**Moringa pods**

**Moringa leaves**

**Harvested moringa leaves**
Cultivation

Irrigation needs: Although okra is mildly drought tolerant, insufficient water will reduce yield. Gently irrigate after sowing or transplanting to reduce seed displacement and then water daily. Once okra have started to flower they become very sensitive to soil moisture deficit. Adequate irrigation at this time will reduce flower drop and increase yield.

Fertilizer: Start with a well-fertilized bed. If leaves appear yellow, apply half a bottle cap of inorganic nitrogen fertilizer around the base of each plant or use a liquid foliar fertilizer.

Harvesting

When to harvest: Harvest young pods when they reach 6–8 cm in length, roughly 70–80 days after planting and when pods are 6–8 days old. Mature pods are too fibrous to consume if harvested late.

How to harvest: When harvesting, leave about 1 cm of stem attached to the pod for ease of handling. Okra are harvested when immature, therefore the seed pod’s skin is very sensitive to physical damage. Harvest every 2–3 days to minimize pods becoming over mature. Okra should not be harvested in the rain or when excessively wet because pods are prone to deterioration.
Okra pests and diseases

APHIDS

Nymphs and adults feed on plant sap and mainly settle on tender shoots and lower leaf surfaces. Aphids secrete honeydew on which sooty mold can grow, which in turn blocks the amount of sunlight needed for the leaves to photosynthesize and thus slows plant growth. Severe infestation causes stunting and leaf curling.

**CONTROL**

- Remove infested plants and release predators (e.g. ladybird beetle, hover flies, lacewings) to control aphids.

BOLLWORM

Bollworms mainly attack terminal shoots initially and then move to flower buds and fruits as they appear. This can result in flower buds dropping. Damage can be visible in young crops (3 weeks old). If damage is severe, top leaves will wilt and the plant will droop. Larvae also attack mature pods to feed on the seeds and leave their frass in tunnels within pods.

**CONTROL**

- Inspect plants regularly and hand pick and destroy any eggs and caterpillars found.
- Preserve natural enemies such as parasitic wasps and predators such as ants, lacewings, and ladybugs.

CUTWORM

Young caterpillars feed on leaves and later on stems. Mature caterpillars can eat an entire seedling. They encircle and cut-off young seedlings at ground level during the night, dragging them into a tunnel within the soil to feed on them during the day.

**CONTROL**

- Delay transplanting slightly until stems are too wide for cutworms to encircle and cut.
- Hand pick caterpillars at night or very early morning before they return to the soil at the beginning of an infestation.
- Plough the field to expose caterpillars to predators and dry them out in the sun.
LEAF MINER

Female flies deposit their eggs within the leaf tissue so that the larvae or cylindrical maggots (soft body and no legs) feed inside the leaf tissue and cause irregular mines as they feed. Most larva cut an opening at the end of the mine and move to the soil for pupation. If several mines are formed in the same leaf, photosynthesis is reduced and the yield may be affected. If severe infestation occurred, the whole plant can die.

**CONTROL:**
- Remove and destroy individual affected leaves.
- Yellow sticky traps may reduce the density of leaf miners and traps can also be used to monitor populations.

![Leaf Miner Images](image1.jpg) ![Leaf Miner Images](image2.jpg) ![Leaf Miner Images](image3.jpg)

EARLY BLIGHT

Leaf spots of early blight are circular, brown, and can reach 12 mm in diameter. Early blight spots have circular ridged bands within them that merge to form a concentric ring pattern that distinguishes it from late blight. Spots appear first on older leaves before progressing upwards on the plant. On young seedlings, a collar rot may develop that girdles the stem at the base of the plant.

**CONTROL**
- Practice crop rotation for two seasons. Tomato, potato, and eggplants are all hosts of early blight and should not be planted in or near fields known to be infected.
- It is very difficult to control early blight once it is established. Focus on preventing early blight from spreading further by using clean seed, rotating fields with crops like maize and legumes that are not hosts, adding lots of organic matter to soil, and cleaning all tools and shoes when leaving infected fields.

![Early Blight Images](image4.jpg) ![Early Blight Images](image5.jpg) ![Early Blight Images](image6.jpg)


*Photo credit: Clemson University – USDA Cooperative Extension Slide Series. Bugwood.org*

*Photo credit: W.R. Stevenson – apsnet.org*
Harvested fruit curing

Cultivation

Irrigation needs: Although pumpkins are mildly drought tolerant, insufficient water will reduce yield. Gently irrigate after sowing or transplanting to reduce seed displacement and then water daily. Once pumpkins have started to flower they become very sensitive to soil moisture deficit. Adequate irrigation at this time will reduce flower drop and increase yield. It is also critical to have sufficient moisture when pumpkin fruits are growing. Any water stress during fruit sizing can lead to the development of blossom-end rot and a reduction in fruit size and yield.

Fertilizer: Start with a well-fertilized bed. If leaves appear yellow, apply half a bottle cap of inorganic nitrogen fertilizer around the base of each plant or use a liquid foliar fertilizer.

Special cultivation practices: Between weeks three to seven after planting, plant growth will be very fast and vines should be trained to grow in the direction desired by the gardener. Training should be done at least twice a week. Start training vines as early as possible, otherwise they become too woody and can be easily damaged if we try to move them at this point. When vine growth is more than what is desired by the gardener, lateral vines can be pruned, especially if they are entangled with neighboring plants. Prune away misshapen fruit (usually fruit with pollination problems or pest damage) and old or sick leaves if they are in danger of damaging other fruits or the whole plant. Young shoots that are non-fruit bearing or trimmed can be harvested for consumption.

Harvesting

When to harvest: Pumpkins should be ready for harvest between 90–100 days after sowing, when the skin has toughened and the fruit has lost its shine. Young non-fruit bearing shoots can be harvested, as well.

How to harvest: Cut pumpkin stems 5 cm from the base of the fruit with a sharp knife. Leave harvested pumpkins in a dry, shaded place for 5–10 days to cure them.
**Pumpkin pests**

**APHIDS**

Nymphs and adults feed on plant sap and mainly settle on tender shoots and lower leaf surfaces. Aphids secrete honeydew on which sooty mold can grow, which in turn blocks the amount of sunlight needed for the leaves to photosynthesize and thus slows plant growth. Severe infestation causes stunting and leaf curling.

**CONTROL**
- Remove infested plants and release predators (e.g. ladybird beetle, hover flies, lacewings) to control aphids.

**WHITEFLY**

Nymphs and adults feed on plant sap and colonize undersides of the leaves. The damage reduces plant vigor. Whitefly can also transmit yellow mosaic virus infection.

**CONTROL**
- Grow seedlings under insect-proof (50–64 mesh) net houses.
- Control whitefly population using plant barriers (maize, sorghum or pearl millet) and yellow or blue sticky traps.

**SPOTTED BEETLES**

Grubs and adults scrape the chlorophyll from the epidermis, which results in a ladder-like window on leaves, flowers and fruits. Heavy infestations can completely destroy young plants.

**CONTROL**
- Manually collect eggs, grubs and adults and destroy.
- Release predators, such as spined soldier bugs, to control grubs.
STRIPED CUCUMBER BEETLE

The larvae and adults feed on several species of cucurbits including cucumber, melon, courgette, and pumpkin; and also other crops such as eggplants, potato, and tomato. Beetles transmit leaf curl virus and bacterial wilt diseases that can cause wilting and death of infected plants.

**CONTROL:**
- Intercrop a legume or white radish with pumpkin to drive the beetles away. The seeds of radish can be sowed in the same furrow with pumpkin.
- Add a thick straw layer between plants to prevent adults from moving from one plant to another.

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THRIPS

Thrips attack a wide range of crops. Thrips mostly feed on foliage, but sometimes suck sap from fruits as well. Infested leaves have silvery feeding scars on the lower leaf surface, especially along the mid-rib and veins, where thrips have sucked the sap. If infestation is severe, leaves turn yellow or brown, and infested fruit is scarred and deformed.

**CONTROL:**
- Grow pumpkin seedlings in insect-proof (50-64 mesh) net houses, or plastic houses to avoid early infestation.
- Use blue sticky traps to monitor thrips and determine when other pest management is required.
- Use mulch and reflective material to reduce thrips incidence.
Sweet potato leaves and tubers

Cultivation

Irrigation needs: Frequent watering is recommended until sweet potato cuttings are established. Once deep roots are developed, sweet potato is fairly drought tolerant and can survive long dry periods. A dry period is required when tubers are forming as too much moisture may result in rotting and cracking of the tubers. Sweet potato cannot stand water logging.

Fertilizer: Start with a well-fertilized bed and ridges. If leaves appear yellow, apply a thin band of inorganic nitrogen fertilizer around the base of each plant or use a liquid foliar fertilizer.

Special cultivation practices: Turn back the vines from time to time to prevent rooting at the nodes of the plant. This is to ensure a more even crop and fewer smaller tubers.

Harvesting

When to harvest: Sweet potato leaves and shoots are ready for harvest after 6–8 weeks. Tubers are ready to harvest when the majority of tubers have reached the desired size for consumption. This is typically between 3–3.5 months from the time of transplanting. Remove the soil around several randomly selected plants to observe tuber size. Sweet potatoes will continue to enlarge if left in the ground, but root diseases and insect damage typically increase with the amount of time roots remain in the soil.

How to harvest: For leaves and shoots, harvest weekly as desired. For tubers, during the dry season, cut the sweet potato vines at the soil level 3–7 days prior to the intended harvest date. During the rainy season, the vines should be left intact until just prior to harvest. Vine removal helps to toughen the skin of the tubers and facilitates harvesting. After vine removal, the sweet potato tubers can be dug out using a hand hoe to loosen the soil and undercut the tubers. Care must be taken to avoid cutting or injury to the tubers. The tubers are lifted out of the ground, separated from the main stem, and temporarily left on top of the soil or put directly into a field container. The tubers should be handled gently to avoid skinning and bruising. Freshly dug sweet potatoes have a very thin and delicate skin that is easily removed.

Preferred climactic conditions

<table>
<thead>
<tr>
<th>Climactic condition</th>
<th>Preferred Conditions</th>
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</thead>
<tbody>
<tr>
<td>Air temperature</td>
<td>Between 25–30°C</td>
</tr>
<tr>
<td>Soil type</td>
<td>Well-drained sandy to sandy-loams</td>
</tr>
<tr>
<td>Climate conditions</td>
<td>Hot-dry</td>
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<tr>
<td>Sun/shade tolerance</td>
<td>Full sun</td>
</tr>
<tr>
<td>Drought tolerance</td>
<td>Medium</td>
</tr>
<tr>
<td>Flood tolerance</td>
<td>Low</td>
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</tbody>
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Seed sowing and spacing

Direct seeding

Plant stem cuttings that contain seven to ten nodes, or are 25–30 cm long, into soil ridges. Use the growing point (apical portion) of the stem for best results. Plant 1–3 stem cuttings per planting hole. Cuttings should be planted one to two days after harvest. Leaves will wilt, but stems should be kept moist by wrapping in a wet sack or placing stems in a bucket of water in between harvesting and planting. Tubers may be stored and replanted prior to the growing season to produce stem cuttings for planting. Only healthy stems and tubers should be used.

Seed depth

Bury 4–5 nodes, or two thirds of the cutting, in the soil.

Between-plant spacing: 30 cm
Row spacing: 75 cm
Sweet potato pests

**WEEVILS**

Adult sweetpotato weevils feed on the epidermis of vines and leaves. Adults also feed on the external surfaces of storage roots, causing round feeding punctures. The developing larvae of the weevil tunnel in the vines and storage roots, causing significant damage.

**CONTROL**

- Dip new cuttings for planting in water and remove weevils.
- Hill up soil around the base of plants to fill in soil cracks and apply sufficient irrigation to prevent soil cracking.

![Photo credit: James Castner, University of Florida entnemdept.ufl.edu](Photo credit: James Castner, University of Florida entnemdept.ufl.edu)

**SWEET POTATO STEMBORE**

Most eggs are laid individually along the underside of the leaves, along the leaf margins. Some are laid on the stem. The larva bores into the main stem shortly after hatching and sometimes penetrates the neck of the storage root. Larval feeding results in enlargement and lignification of the stems at the base of the plant and in the formation of hollow cavities filled with frass. Plants may wilt and die. Attack during the early stages of plant growth may inhibit the formation of storage roots.

**CONTROL**

- Use clean planting material.
- Hilling-up sweet potatoes can contain stemborer infestations because holes made by adults to exit the stems are covered with soil.

![Photo credit: keys.lucidcentral.org](Photo credit: keys.lucidcentral.org)

**BACTERIAL STEM AND ROOT ROT**

Plants develop water-soaked brown to black lesions on stems and petioles. Branches wilt first, followed by the entire plant collapsing. On fleshy roots, rotting is often internal, but sometimes localized lesions with black margins can be observed.

**CONTROL**

- Take cuttings for transplanting from above the soil line.
- Avoid wounding to reduce disease incidence.
- Use less-susceptible cultivars.

![Photo credit: N. Schaad - plantdiseases.org](Photo credit: N. Schaad - plantdiseases.org)

![Photo credit: keys.lucidcentral.org](Photo credit: keys.lucidcentral.org)

![Photo credit: keys.lucidcentral.org](Photo credit: keys.lucidcentral.org)
**Tomato**

### Cultivation

**Irrigation needs:** Tomatoes are highly drought sensitive and insufficient water will greatly reduce yield. Gently irrigate after sowing or transplanting to reduce seed displacement and then water one to two times daily as needed. Once tomatoes have started to flower they become very sensitive to soil moisture deficit. Adequate irrigation at this time will reduce flower drop and increase yield. It is also critical to have sufficient moisture when tomato fruits are growing. Any water stress during fruit production can lead to the development of blossom-end rot and a reduction in fruit size and yield.

**Fertilizer:** Start with a well-fertilized bed. If leaves appear yellow, apply one bottle cap of inorganic nitrogen fertilizer around the base of each plant or use a liquid foliar fertilizer.

**Special cultivation practices:** Tomato plants should be staked two to three weeks after transplanting to prevent fruit from lying on the ground and encouraging air flow throughout the foliage. Indeterminate tomato varieties should be pruned to two main stems to encourage larger fruits to develop.

### Harvesting

**When to harvest:** Tomato fruits are ready for harvesting 2–3 months after planting.

**How to harvest:** When fruits are at the desired ripeness, pluck them off the stem gently, either with or without the cap. Avoid bruising the fruit during harvesting or transferring them out of the garden. Do not allow freshly harvested fruits to sit in the hot sun as this will accelerate spoilage.
Tomato pests and diseases

**SOUTH AMERICAN TOMATO LEAF MINER**

As larvae feed, they produce large “blotch-type” mines in leaves and can burrow in stalks and consume apical buds as well as fruits. The leaf mines later become necrotic and are potential areas for invasion by secondary pathogens. They can destroy tomato plants during all growth stages leading up to 100% losses if timely control measures are not taken.

**CONTROL**

- Remove destroyed plant tissue and fruits immediately.
- Do not plant with or near other nightshades such as potatoes, eggplants, and peppers.
- Practice crop rotation with known non-hosts, such as cucumbers, beets, and sweet potatoes.

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**TOMATO FRUIT WORM**

Young larvae feed on leaves and floral buds, and older larvae feed on floral buds, flowers, and young fruits. The holes are circular and often surrounded by frass (fecal pellets). Larvae feed on the inner contents of the fruit; severely damaged fruits are not edible.

**CONTROL**

- Physical removal of the fruit worms and biopesticides can reduce damage.

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**ARMYWORM**

The larvae of this moth are nocturnal. They actively feed at night and hide during the day. Larvae cause defoliation and they may cut seedlings or young plants at soil level.

**CONTROL**

- Allow chickens to graze in gardens with mature tomato plants.
- Hand remove larvae.
- Promote natural enemies such as bigeyed bugs, minute pirate bugs, and wasps.
**BACTERIAL WILT**

Bacterial wilt is caused by a soilborne pathogen that infects most Solanaceae crops. Mature, fruit-bearing plants are affected first by the wilting of a few leaves quickly followed by the entire plant wilting suddenly. More rapid decline is prevalent in hotter weather. Stems may have a brown discoloration. As plants die, bacterium is released back into the soil from decaying roots and stems. Bacterium can survive for long periods in the soil, even without host plants.

**CONTROL**

- Remove infected plants immediately.
- Use tolerant varieties or graft tomato on tolerant rootstocks.
- Practice crop rotation and do not plant Solanaceae crops for at least three years.
- Disinfect all equipment to avoid spreading the disease to new areas.

**FUSARIUM WILT**

Fusarium wilt is a soilborne fungus that causes yellowing on one side of the plant or leaf. Yellowing begins on older, bottom leaves, followed by wilting, browning and defoliation. Fusarium fungi can survive in the soil or plant debris for up to ten years.

**CONTROL**

- Plant resistant varieties labelled “VF.”
- Remove infected plants from the garden and practice crop rotation. Tomato, potato, pepper, and eggplant are all hosts of fusarium wilt.

**TOMATO YELLOW LEAF CURL**

Tomato yellow leaf curl is a virus spread by whiteflies. Infected tomato plants initially are stunted and leaves of infected plants are small and curl upward. Leaves appear crumpled and have interveinal and marginal yellowing. Plants appear bushy because of shorted internodes.

**CONTROL**

- Use TYLCV-resistant and -tolerant varieties.
- Use virus- and whitefly-free transplants.
- Manage whiteflies.