



# World Vegetable Center

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## International Cooperators' Guide



### ***Suggested Cultural Practices for Bitter Gourd***

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#### **Introduction**

Bitter gourd (*Momordica charantia* L.) is one of the most popular vegetables in Southeast Asia. It is a member of the cucurbit family along with cucumber, squash, watermelon, and muskmelon. It provides essential micronutrients such as vitamin A (green variety), vitamin C, folate calcium and dietary fiber required for good health. Bitter gourd has been used in traditional medicine for managing diabetes and other diseases. In the past decade, scientific evidence increasingly has shown that bitter gourd can contribute to lowering high blood sugar and high blood pressure, and help in maintaining a healthy weight. Native to China or India, the fast-growing vine is grown throughout Asia and is becoming popular worldwide. Depending on location, bitter gourd is also known as bitter melon, karella, or balsam pear.

The immature fruits and tender vine tips are used in a variety of culinary preparations. The fruits and shoots are soaked in salt water to remove some of their bitterness and then boiled, fried or pickled.

The following suggested cultural practices were developed at the World Vegetable Center in the

Taiwan lowlands. Growers may need to modify the practices to suit local soil, weather, pest, and disease conditions

#### ***Climate and soil requirements***

Bitter gourd grows well in mean air temperatures of 24-27 °C and planted in a well drained sandy loam or clay loam soil rich in organic matter. Optimum soil pH is 6.0-6.7. It is normally grown as an annual crop, but can perform as a perennial in areas with mild, frost-free winters. The plant thrives in the tropics and subtropics from lowland areas to altitudes of up to 1,000 m. It is more tolerant to low temperatures compared to other gourds, but cool temperatures will retard growth and frost will kill the plant.

#### ***Choosing a variety***

Hybrid and open-pollinated varieties are available. Hybrids can produce 2-3 times higher yield (25-35 t/ha) compared to open-pollinated varieties (10-15 t/ha), depending upon the management practices, but hybrid seeds are relatively more expensive and must be purchased for every planting. Open-pollinated varieties have the advantage that their seeds may be saved and used for future plantings.

The choice of variety depends on consumer preferences for fruit color, shape, size and skin pattern which vary among and sometimes within countries. For example, there are more than 15 market types of bitter gourd (Fig. 1). Fruit color ranges from white to light green to dark green, and shapes include cylindrical, spindle, and conical types (Table 1). Fruits develop regular or irregular longitudinal ridges and a warty skin, depending on the variety.

Select a variety that is well adapted to your growing conditions and preferred by consumers. Growers are encouraged to compare the performances of different varieties during different seasons to identify superior types.

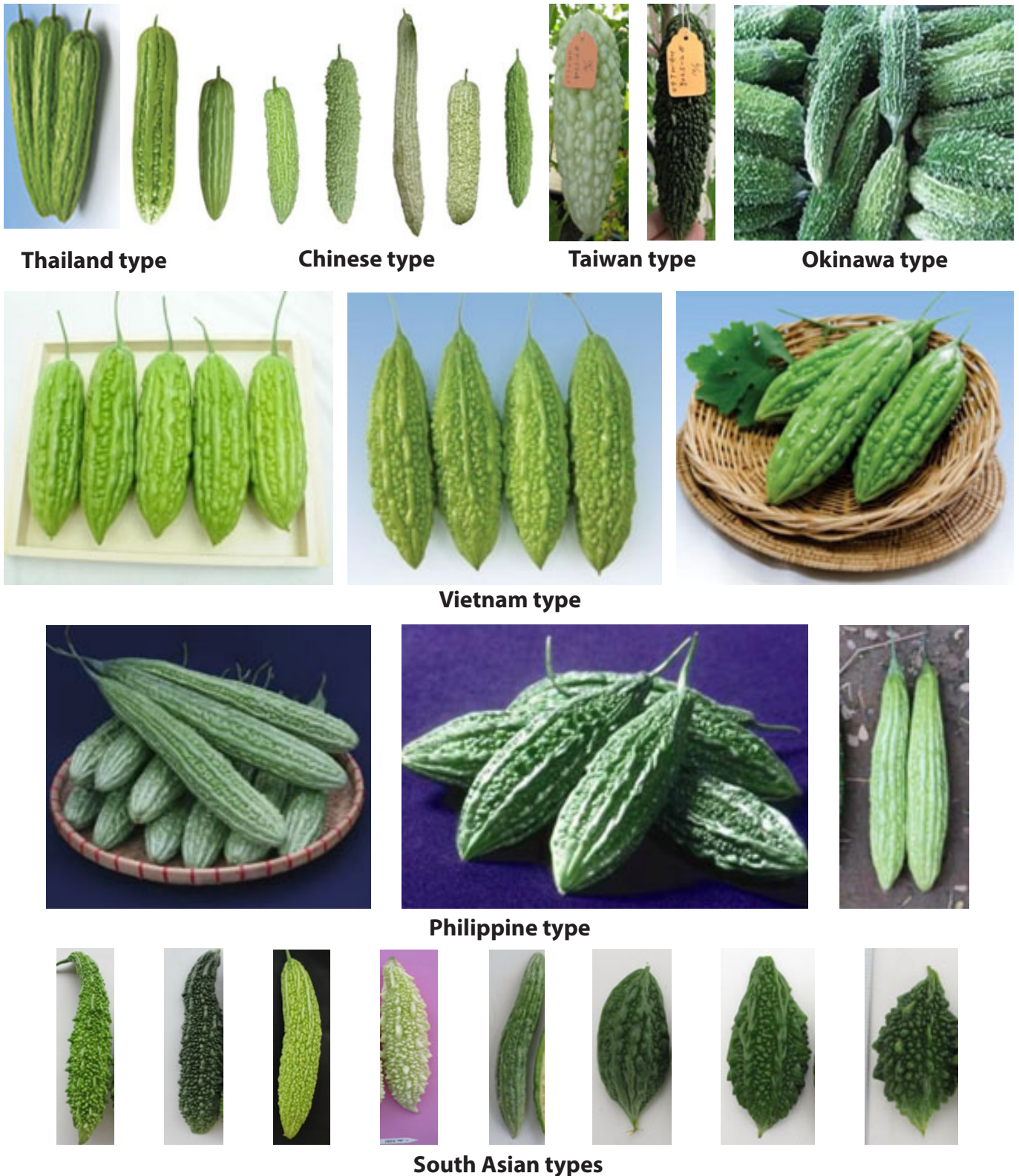


Figure 1. Bitter gourd market types.

**Table 1. Major market types of bitter melon \***

Market type	Fruit				
	Color	Length (cm)	Diameter (cm)	Weight (g)	Shape
Vietnam	Light glossy green	20-22	5-6	240-280	Spindle
	Light green	15-20	6-7	220-250	Spindle
Philippines	Dark green	25-30	5-6	240-300	Cylindrical, blunt or semi-blunt blossom end
Chinese type	Light green, Medium green or Dark green	25-30	6-7	450-600	Blocky, blunt blossom end
	Light green	9-12	4-6	300-600	Triangular
Thailand type	Light green	30-33	7-8	500-550	Cylindrical, semi-blunt blossom end, smooth ridges
Okinawa type	Dark green	38-42	6-7	500-550	Spindle
Taiwan type	Dark green	25-28	7-8	600-800	Spindle
	White	28-32	6-8	500-750	Spindle
South Asian type - short, smooth	Medium green	7-8	3-3.5	55-80	Short, spindle
	Medium green	7-8	2-3	50-70	Short, spindle
South Asian type - half long, spined	Medium green	16-18	3.5-3.7	80-90	Spindle
South Asian type - long, spined	Dark green	20-25	5-6	100-140	Spindle
	Bright green	22-26	3.3-5.0	70-80	Spindle
	White	20-25	3.5-4.0	100-140	Spindle
	White	19-23	3-3.5	100-130	Spindle

\* With input from breeders of East-West Seed, VNR Seed, Hy-Veg-Rasi Seeds

### **Preparing the field**

Thorough land preparation and a well-prepared bed is required. Plow, harrow and rototill the field. Form 20 cm-high beds during the dry season and 30 cm or higher during the wet season using a plow or mechanical bed shaper (Fig. 2). The distance between centers of adjacent furrows is about 150 cm with a 90 cm bed top. In other parts of Asia, farmers adopt row and plant spacing from 1.5-3 m and 0.5-0.9 m, respectively.



Figure 2. Forming raised beds.

## Pre-germination

Moisten a clean piece of cotton cloth or jute sheet; use just enough water to wet this material. It should not be too wet or too dry. Spread the seed in this moistened cloth and roll the cloth into a cylinder shape (Fig. 3). Place it in a dark ventilated area. Keep the cloth moist at all times. After 5 days, sow the just-sprouted seeds in the field or in seedling trays at 2 cm depth. Using sprouted seed for transplanting will ensure uniform seedling stands in the plastic trays or in the field, if direct seeding is practiced.

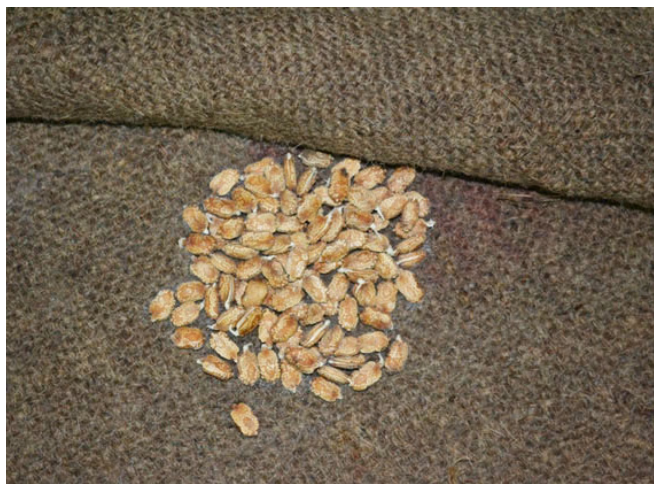


Figure 3. Bitter melon seed.

## Planting

Direct seeding is the most common method of planting. In cooler climates, it may be necessary to start the seedlings in a greenhouse to ensure good germination.

### Option 1. Direct seeding

Optimum plant density differs with variety and row  $\times$  plant spacing, usually ranging from 3,500 to 18,000 plants per hectare. In some intensively managed plantings, a closer spacing of 50 x 50 cm is used, resulting in 40,000 plants per hectare. On raised beds, sow two or three seeds per hole at a depth of 2 cm. Space holes 40–60 cm apart in rows spaced 1.2–1.5 m apart. Plant density using this spacing will range from 13,600 to 17,300 plants per hectare. When planted in warm soil, seedlings will emerge in a week or less. Thin to one seedling per hole after development of four true leaves.

### Option 2. Transplanting

Sow seeds in plastic trays, small plastic pots or containers using a potting mix that has good water holding capacity and good drainage such as peat moss, commercial potting soil, or a potting mix prepared from soil, compost, rice hull, and vermiculite or sand (Fig. 4). Plant one seed per container at a depth of 2 cm. Water the seedlings thoroughly every morning to maintain a moist but not wet soil.

Seedlings are ready for transplanting 10–20 days after sowing or when they are 10–15 cm tall. Bare-root plants will not survive so pull seedlings with their root balls intact before transplanting. Transplant seedlings into the field at plant spacing similar to that used for direct seeding. Start transplanting in the late afternoon (4 PM) to avoid extreme heat and avoid transplanting shock.



Figure 4. Bitter melon seedlings

## Staking and trellising

Bitter melon grows very fast and vines elongate rapidly within two weeks after planting. Thereafter, the plant sends out lateral stems. Staking and trellising will increase fruit yield and size, reduce fruit rot, and make spraying and harvesting easier (Fig. 5).

There are several methods of trellising bitter melon. At WorldVeg, bamboo poles, wood stakes, PVC pipes or other sturdy material are used to provide support and keep the fruit and foliage



Figure 5. Staking and trellising to support vigorous vines.

off the ground. The trellis is arranged either in a lean-to or tunnel structure. The trellis should be 1.8–2.0 m high, constructed from stakes 1.2–1.8 m apart, which is almost similar to the plant row spacing.

For the lean-to type, the stakes are joined between two adjoining beds forming an A-shape structure (Figs. 6, 7). Horizontal stakes are installed at the top joining all other beds. The stakes support the climbing vines and lateral stems. Strings are used to secure adjoining stakes. Plantings are easier to manage and more



Figures 6, 7. Lean-to trellis structures.

productive when stakes 2 m high are used rather than 1 m high string trellises.

For the tunnel type, plants are grown inside an arch-shape structure made of either PVC or galvanized iron pipe (Fig. 8). Plants are supported by bamboo stakes where vines freely climb and reach the top. The vines and lateral stems will then grow along the structure.

Another type of trellising consists of a system of vertical strings running between top and bottom of horizontal wires, or horizontal wires running across all directions on top (Fig. 9).



Figure 8. Tunnel trellis structure.



Figure 9. Horizontal trellis on top of structure.

## Pruning

Bitter melon develops many side branches that are not productive. To improve yield, remove lateral branches until the runner reaches the top of the trellis. Leave 4–6 laterals and cut the tip of the main runner to induce early cropping.

Removal of lateral branches in the first 10 nodes has a positive effect on total yield. Without pruning, most of the female flowers occur between the 10th and 40th nodes, or at a height of 0.5–2.0 m.

### Fertilization

Bitter melon requires a balance of nutrients from organic and chemical fertilizers. Fertilizer application rates depend on soil type, fertility level, and soil organic matter. In sandy soils at the World Vegetable Center, fertilizer application consists of a basal application followed by four side dressings, providing a total of 184 kg N, 112 kg P<sub>2</sub>O<sub>5</sub> and 124 kg K<sub>2</sub>O per ha (Table 2). In clay or heavy texture soils, the entire amount of P, and one-third of N and K is applied before planting, either by broadcasting and tilling or by banding a few cm deep and to the side of the plant row in the bed. The balance of N and K is applied in two or more side dressings. No matter the soil type, the first side dressing is applied when plants have four to six true leaves. Subsequent side dressings are applied at two-week intervals. Compost or manure can be used to satisfy the basal application of organic fertilizer.

**Table 2. Recommended fertilizer rates (kg/ha) for bitter melon based on production practices at World Vegetable Center, Shanhua, Taiwan**

Timing	N	P <sub>2</sub> O <sub>5</sub>	K <sub>2</sub> O
Basal (organic)	28	28	28
Basal (inorganic)	36	54	36
Side dressing 1	30	7.5	15
Side dressing 2	30	7.5	15
Side dressing 3	30	7.5	15
Side dressing 3	30	7.5	15
Total	184	112	124

### Irrigation

Bitter melon will not tolerate drought. Maintain good soil moisture in the upper 50 cm of soil where the majority of roots are located. At the World Vegetable Center, fields are furrow-irrigated every 10 days during the cool-dry season, and weekly during the hot-dry season.

During the rainy season, drainage is essential for plant survival and growth. Trickle or drip irrigation is an efficient method of supplying water and nutrients to bitter melon.

### Pollination

Bitter melon begins to flower at 45 to 55 days after sowing and vines will bloom for about six months. Flowers are cross-pollinated by insects, especially bees. Pollination can be a problem during the wet season since bees are less active during overcast conditions. Each flower opens at sunrise and remains viable for only one day. Pollen loses viability as the day advances and may be fully inviable by midday. To ensure good pollination and avoid the need for hand pollination, introduce beehives.

Bitter melon is monoecious, in other words, male and female flowers are borne separately on the same plant (Fig. 10). The number of male flowers normally exceeds female flowers by about 25:1. Long days cause male flowers to bloom up to two weeks before female flowers, while short days have the opposite effect. As mentioned earlier, pruning the lower lateral branches increases the number of flowers per plant by increasing the number of flowers on higher laterals.

In Taiwan, yield of bitter melon is increased by grafting with luffa (*Luffa* spp.). *Luffa* is resistant to the fusarium wilt pathogen and is more tolerant to flooding.



Figure 10. Bitter melon flowers: female (left) and male (right).

## Controlling weeds

Mulching is commonly used for bitter gourd crops grown on raised beds (Figs. 6–8). Use organic or plastic mulch depending on availability. Organic mulch such as dry rice straw or grass is usually available and cheaper than plastic mulch. If you use organic mulch, be sure that it is free of weed seeds. Several herbicides are available, but be sure to select a herbicide recommended for bitter gourd. Hand or hoe weeding can be performed as needed.

## Pest and disease control

Bitter gourd is susceptible to many of the same diseases that affect other cucurbits. Suggestions for control of common bitter gourd diseases and insect pests are presented in Table 3 and the disease and pest symptoms are shown in Figures 11-20.

Chemical control of insect pests should be done only when significant damage occurs. Avoid pesticides that kill or inhibit the development of beneficial organisms especially the pollinators. Choose pesticides that last only a few days. Wear protective clothing and follow all instructions carefully on the label when applying pesticides.

**Table 3. Common diseases and insect pests of bitter gourd, mode of transmission, symptoms and control measures**

Conditions for disease occurrence	Symptoms	Control
<p><b>Downy mildew: <i>Pseudoperonospora cubensis</i> (Fig. 11)</b> Disease develops rapidly in moderate temperatures (15-30 °C and high humidity (100% for 6 hr). Sufficient leaf wetness period is important for disease development. Sporangia are spread by wind, rain splashes, overhead sprinklers, and contaminated tools.</p>	<p>Small angular and yellowish to pale green lesions coalesce into large spots limited by leaf veins, which turn brown or necrotic later. Sporulation as greyish to black molds will be observed on the underside of leaves under high relative humidity and cool conditions.</p>	<p>Good field sanitation (remove and destroy infected plant parts) and practices (avoid high plant density and provide good air circulation) can reduce disease incidence and severity. Regularly apply protectant and systemic fungicides such as mefanoxam, metalaxyl, mancozeb, copper based and sulfur based helps in the disease management.</p>
<p><b>Powdery mildew: <i>Podosphaera xanthii</i> (Fig. 12)</b> The favorite conditions for disease development are cool temperatures (20-26°C) and high humidity. The disease progress will stop at high temperature (&gt;35°C). Shading and poor ventilation increases disease occurrence. Conidia can be transmitted by air currents and splashing water.</p>	<p>Symptoms of white powdery molds appear first on older and shaded lower leaves. Thereafter, white powdery molds with mycelia and conidia covers the leaves, vines, and stem. The infected leaves turn yellow, shrivel and die.</p>	<p>Use resistant varieties if possible. Avoid overuse of N fertilizer. Good field sanitation and practices helps in disease control. Fungicides such as Azoxystrobin, triadimefon, thiophanate methyl and bicarbonates and dithiocarbamate are effective. Apply fungicide before symptom appearance if plants are susceptible.</p>
<p><b>Gummy stem blight: <i>Didymella bryoniae</i> (Fig. 13)</b> High humidity is required for disease occurrence and continuous leaf wetness helps lesion expansion. Conidia and ascospores might be found simultaneously in different lesions. Both can be disseminated by rain splashes, overhead sprinklers, and contaminated tools.</p>	<p>Light brown spots surrounded by a yellow margin appear on leaf edges and expand to the center of the leaf, usually forming V-shape lesions. Infected leaves turn yellowish and die if disease is severe. Elongated lesions are often found at or near stem base and result in stem rot and plant wilting. Fruit infections usually start from the blossom end.</p>	<p>Good field sanitation and practices helps in disease control. Fungicides such as Pyraclostrobin, chlorothalonil, mancozeb are commonly used. Apply fungicide as early as symptoms are observed. Crop rotation with non-cucurbit crops can help reduce inoculum in the soil.</p>
<p><b>Cercospora leaf spot: <i>Cercospora</i> spp. (Fig. 14)</b> Warm weather and high humidity favor disease development. Conidia can be transmitted by wind, rain splashes, and contaminated tools.</p>	<p>Leaf and fruit can be infected, especially in hot humid conditions. Leaf spots start as small, round, brown lesions, often with white or light tan center. Spots may be surrounded by a yellow halo. Spots and lesions coalesce blighting infected leaves. Fruit spots are small, circular, and sunken.</p>	<p>Good field sanitation and practices helps eliminate inoculum source in the field. Avoid overhead irrigation. A regular fungicide application such as benomyl followed with copper oxychloride or chlorothalonil are effective. Rotation with non-cucurbit crop is recommended.</p>

<p><b>Fusarium wilt: <i>Fusarium oxysporum</i> f.sp. <i>momordicae</i></b> Sandy and acidic soils, poor drainage, and 20-27°C of soil temperature are conducive to the disease. Infection occurs through root tips and is aided by wounds created by insects and nematodes feeding. The disease is primarily disseminated by infested soil, plant parts, and contaminated tools.</p>	<p>Infected plants show partial or complete wilt with or without yellowing. One-sided wilt might also occur. Visibly vascular discoloration inside infected stems and roots is important diagnostic symptoms.</p>	<p>Avoid planting in contaminated land with previous wilting history. Increase soil pH value by liming and reduce N level in the soil. Crop rotation is recommended. Grafting bitter melon on <i>Luffa</i> spp. is a good alternative. Soil drenching with carbendazim and carboxin applied once before transplanting and twice after transplanting can reduce disease incidence. Remove and destroy infected plants as soon as possible.</p>
<p><b>Root-knot nematode: <i>Meloidogyne</i> spp.</b> Nematode populations increase rapidly under hot or humid conditions.</p>	<p>Above ground symptoms include stunting, yellowing and wilting. Roots develop knots (galls).</p>	<p>Grow resistant varieties. Adopt fallow plowing and rotation with paddy rice.</p>
<p><b>Diseases caused by begomoviruses (<i>Geminiviridae</i>) (Fig. 15)</b> Several different begomovirus species can cause disease including Bitter melon yellow vein virus (BGYVV) and <i>Squash leaf curl Philippines virus</i> (SLCuPV). All are transmitted in a persistent manner by whiteflies (<i>Bemisia tabaci</i>), but most are not transmitted mechanically or by seed.</p>	<p>Symptoms somewhat variable depending on virus species and age of plant at time of infection, but can include leaf curling or cupping with leaf deformation. There may be general leaf yellowing, yellow mosaic or yellow veins. Mixed infection with other viruses is common in some areas and this may extend the range of symptoms observed.</p>	<p>Employ good field sanitation to remove sources of infection such as weeds, volunteer plants and rogue infected plants as soon as seen. Plant new crops at a distance from older and infected crops. Use reflective plastic mulch to repel whiteflies. Start seedlings in whitefly-proof net structure. Manage whitefly populations with systemic insecticides, but rotate different active ingredients to prevent buildup of insecticide resistance.</p>
<p><b>Diseases caused by criniviruses (<i>Clsteroviridae</i>)</b> Cucurbits can be infected by <i>Cucurbit chlorotic yellows virus</i> (CCYV), <i>Cucurbit yellow stunting disorder virus</i> (CYSDV), <i>Lettuce infectious yellows virus</i> (LIYV) or <i>Beet pseudo yellows virus</i> (BPYV), though CCYV is probably the most prevalent in bitter melon. They are transmitted by whiteflies (<i>Bemisia tabaci</i> or <i>Trialeurodes vaporariorum</i> for BPYV) in a semi-persistent manner. Criniviruses are phloem limited, cannot be mechanically (sap) transmitted, and are not transmitted by seed.</p>	<p>The different criniviruses cannot be distinguished based on symptom development. They all start with interveinal chlorotic spots on the lower (older) leaves and these coalesce to give a bright yellow color, which can often be confused with natural senescence, physiological and/or nutritional disorders, or pesticide phytotoxicity. The leaves may curl downward slightly, remain turgid and become brittle. Symptoms spread towards the new growth but never reach the young leaves. Generally, fruit shape and color are not affected but fruit weight and sugar content are reduced.</p>	<p>Because the vector whiteflies can develop resistance to commercially available insecticides, management of these viruses should be through integrated pest management (IPM) approaches including good field sanitation, vector and virus host free periods, protecting seedlings with vector-proof net cages prior to planting out in the field, and use of reflective mulch to deter whiteflies and help control alternative host weeds.</p>
<p><b>Diseases caused by potyviruses (<i>Potyviridae</i>) (Fig. 16)</b> <i>Papaya ring spot virus</i> (PRSV type W [watermelon] and type P [papaya]), <i>Watermelon mosaic virus</i> (WMV) and <i>Zucchini yellow mosaic virus</i> (ZYMV) can infect bitter melon; they are transmitted in a non-persistent manner by several different aphid species, and can also be mechanically transmitted.</p>	<p>Infected plants may show light or dark green or chlorotic mosaic patterns on the leaves. Leaves may also be malformed, blistered and/or narrowed and have green vein-banding, or chlorotic ring spots. Fruits may be small and malformed with green mottle and/or water-soaked lesions.</p>	<p>Employ good field sanitation to remove weeds and volunteer plants that can act as alternative hosts and reservoirs for virus and aphid vectors. Avoid planting near other susceptible crops. Use reflective mulch to repel aphid landing and suppress weed hosts. Because transmission by aphids is generally very rapid, insecticides are generally ineffective at preventing virus spread. Fast-acting insecticides and mineral oil sprays may be useful to knock down large populations of aphids if observed (e.g. on host weeds).</p>



<p><b>Disease caused by poleroviruses (Luteoviridae) (Fig. 17)</b>  <i>Cucurbit aphid-borne yellows virus</i> (CABYV), <i>Melon aphid-borne yellows virus</i> (MABYV) and <i>Suakwa aphid-borne yellows virus</i> (SABYV) are all transmitted by aphids in a persistent manner and cannot be mechanically transmitted. They are not seed transmitted.</p>	<p>Older infected leaves have chlorotic patches easily confused with senescence and nutrient deficiency. Younger leaves have interveinal clearing. Leaves tend to become thicker with edges rolling upward, and may develop a metallic sheen.</p>	<p>Raise seedlings in aphid-proof net cage or net house. Employ good sanitation in the field, removing infected plants and debris as soon as possible and eradicate weeds and volunteer host plants. Monitor aphid populations and control using systemic insecticides. Use reflective plastic mulch to deter aphids and control weeds.</p>
<p><b>Diseases caused by tospoviruses (Bunyaviridae)</b>  <i>Watermelon silver mottle virus</i> (WSMoV), <i>Watermelon bud necrosis</i> (WBNV), <i>Melon yellow spot virus</i> (MYSV) and <i>Zucchini lethal chlorosis virus</i> (ZLCV) are transmitted by thrips in a persistent manner and can be mechanically transmitted given the right conditions. They are not seed transmitted.</p>	<p>Symptoms range from mild chlorotic mosaic or yellow spots, through to more severe mosaic with necrotic patches or ring spots on the leaves. Internodes can fail to grow fully and leaves remain small and distorted. Buds can become necrotic.</p>	<p>Grow seedlings in thrips-proof net cages before transplanting to the field. Plant new crops away from other cucurbit crops. Protect seedlings at transplanting with a drench of Imidacloprid. Use reflective mulch to repel thrips. Use blue sticky traps to trap and monitor thrips. Employ good field sanitation – keep fields clean of volunteer cucurbit plants and weed, and remove infected plants quickly. If thrips population starts to increase, treat with a systemic insecticide.</p>
<p><b>Diseases caused by tobamovirus (Virgaviridae)</b>  <i>Cucumber green mottle mosaic virus</i> (CGMMV) has no known biological vector, but is readily sap transmitted through contact and handling of contaminated plants or pruning/harvesting tools. It is probably also transmitted in seed of some cultivars.</p>	<p>Leaves can develop mottling or mosaic, often with leaf distortion, vein clearing and chlorotic spots.</p>	<p>Use virus-free seed from a reliable source. Keep fields tidy and free of weeds and volunteer plants that may be virus reservoirs. Workers should wash hands and tools regularly with detergent, skimmed milk or tri-sodium orthophosphate to prevent carryover of virus from one plant to the next. Remove infected plants and destroy immediately.</p>
<p><b>Disease caused by phytoplasma (Mycoplasma-like-organism): (Fig. 18)</b> Phytoplasmas from several different 16Sr phylogenetic groups have been associated with little-leaf or witches broom diseases of bitter melon. Phytoplasmas are transmitted by leafhoppers or psilids and are not mechanically or seed transmitted.</p>	<p>Little-leaf: Leaves fail to expand normally and remain small and somewhat succulent. Excess shoot proliferation leads to witches broom or dense clusters of little leaves. Infected plants stop flowering, and flowers are replaced with more vegetative shoots.</p>	<p>Grow seedlings in a vector-proof net cage, and protect seedlings at transplanting with a drench of systemic insecticide such as Imidacloprid. Maintain good field sanitation eradicating weeds and volunteer plants that can harbor the phytoplasma. Remove and destroy any infected plants immediately.</p>
<p><b>Melon fly: <i>Bactrocera cucurbitae</i> (Fig. 19)</b></p>	<p>Feeding by the larvae causes yellowing and rotting of the fruit</p>	<p>Adopt good field sanitation. Wrap the fruit with paper bags or nylon net. Use attractants (kairomones) for suppression of male population.</p>
<p><b>Aphids: <i>Aphis gossypii</i> (Fig. 20)</b></p>	<p>Stunted growth, infested leaves curl downwards, yellowing and cupping of leaves, presence of honeydew and black sooty mold</p>	<p>Prune heavily infested plant parts, use yellow sticky traps and use plastic mulch. Use recommended insecticides such as thiamethoxam, acetamiprid, abamectin, neem, dimethoate, fenthion and diazinon.</p>



Figure 11. Downy mildew.



Figure 15. Begomovirus.



Figure 12. Powdery mildew.



Figure 16. Potyvirus.



Figure 13. Gummy stem blight.



Figure 17. Cucurbit aphid-born yellow virus.



Figure 14. Cercospora leaf spot.



Figure 18. Phytoplasma little-leaf



Figure 19. Damage by melon fruit fly.



Figure 20. Aphids.

## Harvesting and handling

Bitter melon requires close attention at harvest time. The fruits develop rapidly and must be harvested frequently to keep them from becoming too large. Normally it takes 15–20 days after fruit set or 60–75 days from planting for fruit to reach marketable age, depending on the variety. However, bitter melon can be harvested at earlier stages depending on the purpose for which it will be used (Fig. 21). Fruit should be shiny green, thick and juicy, and the seeds should be soft and white. Harvest every 2–3 days using a pair of scissors or a sharp knife to cut the fruit stalk. If a fruit remains too long on the vine, it will turn spongy, sour, yellow or orange, and split open.

Bitter melon yield will vary depending on variety, crop management, and the environment. A yield of 20–30 t/ha is excellent and some F1 hybrids may yield up to 40 t/ha.

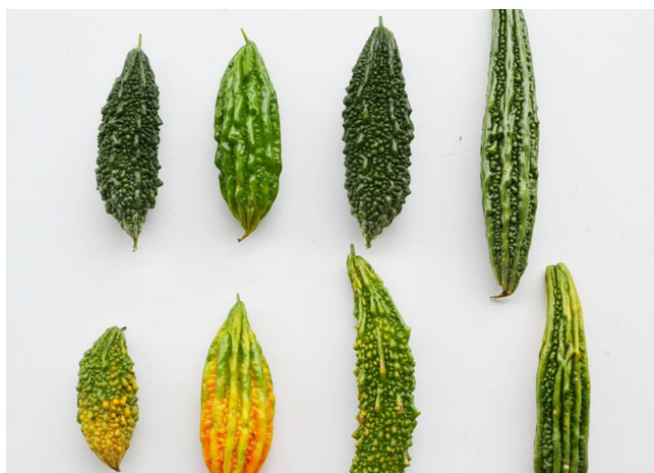


Figure 21. Bitter melon fruits at marketable (upper row) and unmarketable (lower row) stage

Fruits of bitter melon do not keep long and should be marketed immediately. Remove damaged and deformed fruits. Carefully arrange fruits in bamboo baskets or boxes (Fig. 22) and store in a cool place at 12–13°C with 85–90% relative humidity. Under this condition, fruit storage life can be extended 2–3 weeks. Bitter melon fruit is sensitive to chilling and damage may occur if stored at temperatures  $\leq 10^{\circ}\text{C}$ . Do not store fruits above 13°C or fruits may turn yellow and split. Keep harvested fruits away from other fruits (such as banana, pineapple and apple) that release large amounts of ethylene, a ripening hormone.



Figure 22. Pack fruit carefully in boxes or baskets to prevent damage.

## Preparing Bitter Melon

The tender fruit of bitter melon can be eaten as a salad, consumed as juice, or cooked in different dishes. The leaves and seeds also can be used for cooking. Bitter melon can be substituted for different vegetables in your favorite dishes. In Asian cultures, the white spongy pulp of the fruit is usually removed due to its strong bitterness. In India, bitter melon is stir-fried with spices or stewed in a curry. To reduce the bitterness, the bitter melon slices are soaked in tamarind water. Soaking bitter melon slices in ice water, salt and lemon juice can lessen the bitterness. Bitter melon slices can be baked into chips. Dried fruits and leaves are made into tea, which is popular in Southeast Asia. Fresh bitter melon juice mixed with fruit is a refreshing drink for a hot day.



## Guava pineapple bitter gourd juice

Servings: 4-6

### Ingredients

- 1 cup guava chunks
- 1 cup apple chunks (optional)
- 1 cup pineapple chunks
- 1 cup ice cubes
- 1 cup bitter gourd chunks (any variety of bitter gourd)
- Drinking water
- 2 tbsp of honey (or enough to taste)

### Directions

1. Rinse and wash the fruits and bitter gourd thoroughly.
2. Remove the pineapple skin and cut the fruit into small chunks.
3. Cut the bitter gourd open lengthwise and remove the seeds and pulp. Cut 1 cup of bitter gourd chunks.
4. Put the fruits and bitter gourd in a blender, add ice cubes and honey. Add enough drinking water into the blender to fill half of the blender volume.
5. Blend twice on high speed. Then, blend continuously on low speed for 2 minutes or until smooth. Serve the juice chilled and fresh. Enjoy!



## Pan-fried mixed vegetables

Servings: 2

### Ingredients

1 tbsp vegetable oil  
1 onion, chopped  
1 carrot, chopped  
1 bitter gourd, chopped  
1 eggplant, chopped  
1 small sweet pepper  
1 tomatoes, chopped  
Salt to taste  
A pinch of black pepper

### Directions

1. In a medium sized pan, heat oil and fry onions, carrots and bitter gourd.
2. Add tomatoes and salt, mix and cover to let it cook.
3. Add a small amount of water and cover the pot until vegetables are thoroughly cooked.
4. Season with black pepper and serve hot as an accompaniment to rice or other cereals.



## Bitter gourd noodle

**Servings: 3**

### Ingredients

- 1 bitter gourd
- 1 packet of noodles
- 1/4 cup cabbage
- 1/2 carrot
- 1/2 green pepper, sliced
- 1/2 tomato
- 2 tsp tomato sauce (optional)
- 1/2 tsp soya sauce (optional)
- Salt to taste
- 1 tbsp vegetable oil

### Directions

1. Cut bitter gourd into thin slices and remove the seeds.
2. Heat oil in a frying pan and fry the bitter gourd slices. Set aside.
3. In a small saucepan, cook the noodles as directed on the noodle pack.
4. Heat oil in a frying pan and on medium heat, stir-fry all the vegetables for 3 minutes.
5. Add tomato sauce, soya sauce, salt, noodles and fried bitter gourd. Mix thoroughly and serve hot.



## World Vegetable Center

The World Vegetable Center, an international nonprofit research and development institute, is committed to alleviating poverty and malnutrition in the developing world through the increased production and consumption of nutritious and health-promoting vegetables.

The Center mobilizes resources from the public and private sectors to disseminate improved varieties and production methods in developing countries. We help farmers increase vegetable harvests, raise incomes in poor rural and urban households, create jobs, and provide healthier, more nutritious diets for families and communities.

### Bitter Gourd Project

The Bitter Gourd Project, funded by the Federal Ministry for Economic Cooperation and Development, Germany, studies the potential of bitter gourd in managing type 2 diabetes and promoting good health. Project collaborators: World Vegetable Center, Justus-Liebig University (Germany), Punjab Agricultural University (India), Avinashilingam Deemed University for Women (India), Kilimanjaro Christian Medical Centre (Tanzania), and National Taiwan University (Taiwan).

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