

Introduction



Bitter gourd (*Momordica charantia* L.), locally known as 'ampalaya' or 'amargoso', is also called African cucumber, alligator pear, balsam pear, bitter cucumber, bitter gourd, bitter melon (English), 'foo gwa yip,' 'fugua' (Chinese), 'kaveli' (Hindi), 'paria' (Indonesian), 'reishi' (Japanese), 'ssunoi' (Korean), 'peria' (Malaysian), 'periakatak,' and 'mara' (Thai).

It is one of the most popular vegetables in the Philippines as well as in other Asian countries such as China, Taiwan, Vietnam, Thailand, and India. The plant is grown mainly for the immature fruits although the young leaves and tips are also edible.

Uses and Nutritional Value

The leaves and fruits are used as vegetables and are excellent sources of Vitamin B, iron, calcium, and phosphorus. It has twice the amount of beta carotene found in broccoli and twice the calcium content of spinach.

Slight soaking of the cut fruits in warm salty water before cooking removes some of the bitterness. The

manner of cooking can also reduce the bitter taste. Despite its bitter taste, it has become a popular nutritional drink for added vim and vigor.

Ampalaya has long been recognized for its potential as an adjunct or supplement to traditional therapeutic regimens in the treatment of diabetes mellitus. Other therapeutic claims include body detoxification (including removal of nicotine), strengthening of the immune system, and fertility regulation. It is also believed to possess astringent, vulnerary, parasiticide, anthelmintic, purgative, emetic, antipyretic, febrifuge, emmenagogue, cooling, and tonic properties.

Per 100 grams edible portion, the fruit contains:

Nutrient	Amount
Water (g)	93.5
Energy (Kcal)	25.0
Protein (g)	0.9
Fat (g)	0.4
Dietary Fiber (g)	1.8
Carbohydrates (g)	4.5
Ash (g)	0.7
Calcium (mg)	42.0
Phosphorus (mg)	38.0
Iron (mg)	0.8
Vitamin A (µg)	33.0
Thiamine (mg)	0.05
Riboflavin(mg)	0.04
Niacin (mg)	0.2
Ascorbic acid (mg)	40.0

Source: The Philippine Food Composition Tables, 1997. Food and Nutrition Research Institute-Department of Science and Technology (FNRI-DOST).

Production Management

Ampalaya, in conventional production, is sprayed heavily with pesticides unlike in organic production. The major pest of ampalaya is fruit fly, which can be effectively and safely managed by bagging the fruits at the right stage. Infestation can also be reduced using fruit fly attractants.

Varieties

The common varieties in the Philippines are the Sta. Rita and the 'Native,' although the light green and blocky types with broad shoulders which are generally recognized as the Chinese type, are becoming popular. Color varies from white to dark green and wartiness ranges from jagged and triangular to smoothly undulating.

Among the varieties that perform well under organic conditions are the Sta. Rita and Makiling. Other landraces are also good varieties for organic production.

Soil and Climate Requirements

Bitter gourd grows best in well-drained sandy to sandy loam soils which are high in organic matter. Alluvial soil along the river beds is also good for production of bitter gourd. A pH range of 6.0–7.0 is considered optimum.

It is a warm-season crop adapted to low- and mid-elevation areas. A temperature range of 24–27 °C is considered optimum for vine growth. The seed germinates faster at temperature higher than 18 °C. High humidity at the time of vegetative growth renders the crop susceptible to various fungal diseases.

Land Preparation

Plow and harrow the field crosswise once or twice. Set furrows at a distance of 1.5–4.0 m depending on the type of trellis that will be used.

Mulching

Plastic mulch can be used to suppress weed growth and conserve soil moisture. Use a 75-cm wide mulch to cover the beds. After making the raised beds and incorporating manure, lay on the plots the plastic mulch with the silver side up. To ensure that the plastic

is well stretched, use it only during the warmest part of the day. Secure the ends and the sides with soil. Make holes 0.5–0.75 m apart using heated tin cans with handle. The plastic mulch can be used in three croppings to save on land preparation and weed control. Rice straw and grass clippings can also be used for mulching.

Planting

Seed requirement for one hectare is 2–3 kg. Pre-germinate the seeds by clipping the hard seed coats first to facilitate water absorption, then soak them in water or roll in a wet rag overnight. Sow 1–2 pre-germinated seeds/hill in beds or furrows at a distance of 0.5–0.75 m. An alternative method is to grow the seedlings in plastic trays for 2 weeks, then transplant one seedling per hill. This saves time in field management and reduces seed requirement. Water the hills before and after sowing or transplanting.

Trellising

Bitter gourd needs strong overhead support for its growth. The plants trailed on trellises continue to give yield for 4–6 months as against 3–4 months when trailed on the ground without support. Fruit quality is also better when trellised. In the double row system, plant at a spacing of 2.5 m x 1 m x 0.75 m. Prepare plots/raised beds 1 m between adjacent beds and 2.5 m apart between the twin beds. Provide irrigation canals between the twin beds. Put up bamboo posts along the beds at 3 m apart, 0.5 m deep and 2 m high. Setup braces at the end of the rows to further support the trellis. Tie a network of wires to connect the poles at the top then set up rows of wire or nylon string on the network of wires running along the rows to support the vines in the overhead trellis. In the vertical portion of the trellis, layout 2–3 horizontal nylon strings and vertical straws (30 cm apart) to support the climbing vines. The vines take about 1.5–2 months to reach the

top of the trellis, thus, at the initial stages of growth, the vines should be trained to crawl on the vertical trellis.

Another trellising method is the continuous overhead trellis with the rows 2–3 m apart and hills spaced at 0.5–1.0 m. The “A” type of trellis is also used.

Grow permanent live trellis around the area such as ‘madre cacao’ (*Gliricidia sepium*) and ‘malunggay’ (*Moringa oleifera*) as main posts for the trellis. The trimmings from these plants are a good source of nitrogen.

Practice crop rotation by planting legumes after one cropping cycle of ampalaya. Planting legumes such as pole sitao and snap beans prevents buildup of pests and diseases.

Pruning

Pruning of all branches below the overhead trellis is practiced in some parts of the country. However, it is recommended to prune only the weak and non-productive vines. Leave the vigorous vines for better yield quality.

Fertilization

Organic vegetable farming uses organic fertilizers and plant food supplements prepared from natural sources.

The fertilizer requirement depends on target yield, variety, soil fertility, climate, and planting season. The general fertilizer recommendation per hectare is 50–100 kg N, 40–60 kg P_2O_5 and 30–60 kg K_2O . Generally, 3 t/ha of well-decomposed animal manure or vermicompost is mixed with the soil during plowing or in the hills as basal before planting. Based on soil analysis, the balance can be applied as organic fertilizer splits at 3–4 weeks interval depending on season and growth of the plants. Compost tea, manure tea, and other natural farm inputs such as fermented plant juice (FPJ), fermented fruit juice (FFJ), fish amino

acid (FAA), and calcium phosphate from egg shells can also be used.

To prepare manure tea, soak $\frac{3}{4}$ sack (30 kg) of dried cow or horse manure in a plastic drum with 180 L of water. Soak for 5–7 days with frequent stirring. To prepare FPJ, mix three parts of chopped plant shoots or banana trunk with one part of raw sugar or molasses. Ferment the mixture for 5–7 days. Dilute the FPJ or manure tea at 1 part tea to 20–40 parts water, then drench on the plots or use as foliar fertilizer. The rate and frequency of fertilization depend on the plants’ vigor.

To prepare FFJ, mix overripe fruits and peelings (2/3 part) with 1/3 part raw sugar and molasses and ferment for 7 days. For FAA, mix fish trashes with equal part molasses. Ferment the mixture for around 2 weeks.

Calcium phosphate is prepared from egg shells, fish bones and animal bones. Char and grind these materials and mix with 10 parts natural vinegar then allow to stand for 2 weeks.

Irrigation

During the rainy season, irrigation is done only when needed. Irrigate one day before planting and at 4–5 days after planting. Subsequent irrigation is done at weekly intervals. It is necessary to maintain the moisture at the root zone to promote rapid taproot development. Mulching with rice straw, grass trimmings, or plastic can minimize moisture loss.

Weeding

Frequency of weeding is 2–3 times, with the first one done at 30 days after planting. Subsequent weeding is done monthly or as needed. Only light weeding is done if plastic mulch is used. Weeds between rows can just be trimmed to encourage presence of natural enemies of insect pests.

Pest and Disease Management

The most serious pest of bitter gourd is the fruit fly (*Bactrocera cucurbitae* [Coquillett]). The adult lays eggs on the fruit and the larva tunnels inside, causing deformation and fruit rot. Set up fruit fly traps with methyl eugenol and cue-lure, protein baits or a mixture of vinegar or 'tuba' (coconut wine) and molasses. Bag the female flower after pollination with nylon net for best control of the pest. Collect the affected fruits and bury them to prevent further spread.

Bacterial wilt is a serious soil-borne disease especially in upland areas. Plants wilt and die at the start of fruiting period. To control this disease, graft bitter gourd with sponge gourd ('patola'), bottle gourd or wax gourd. Grafting bitter gourd is a viable option that enables the plant to resist bacterial wilt. Besides, the plant grows more vigorously and its picking period becomes longer.

Grow marigold, cosmos, basil, and amaranth around the area to repel insect pests. Basil is also a good fruit fly attractant. Place the basil leaves inside an improvised plastic container with holes. Basils' strong aroma will attract fruit flies and once inside the container, they are trapped.

Pest and disease management options in ampalaya.

Pests

Cucurbit beetle (<i>Aulcophora similis</i>)	Dust seedlings with wood or rice hull. Spray with soap solution (4 tbsp soap/ 16 L water).
Aphids (<i>Aphis gossypii</i>)	Spray hot pepper (100 g macerated hot pepper/16 L water) and soap solution. Spray 'Langkawas' (<i>Alpinia pyramidata</i>) extract.
Fruit fly (<i>Bactrocera cucurbitae</i>)	Collect and bury infested fruits. Use fruit fly attractant such as methyl eugenol with cue-lure or 'tuba' (coconut wine) with molasses (2 parts 'tuba' and 1 part molasses). Wrap fruits with nylon net 1–2 days after the fruits have set.

Diseases

Cutworm (<i>Spodoptera litura</i>)	Spray with commercial preparations of <i>Bacillus thuringiensis</i> and Nuclear Polyhedrosis Virus (NPV). Collect NPV- infected cutworm larvae and store in the freezer for later use. These can be macerated then diluted at 12 infected larvae/ 16 L water. Langkawas extract can also be sprayed.
Ampalaya mosaic virus	Remove sources of inoculums.
Bacterial wilt	Rotate planting with non-host crops such as pole sitao. Plant in well-drained soils. Plant ampalaya after rice to reduce the chance of bacterial wilt infection. Graft seedlings with bacterial wilt resistant rootstock such as patola or wax gourd.
Downy mildew	Remove infected leaves. Spray with compost tea. Compost tea is prepared by soaking ½ sack (15 kg) of mature compost in ¾ drum (200-L capacity) of water for 5–7 days. Dilute the tea to 20 parts water and spray on the plants.
Little leaf	Remove nearby sources of inoculum such as other cucurbits (squash, patola) with little leaf. Practice crop rotation.
'Namamarako'	Use organic fertilizer. Spray with boron fertilizer following the recommended rates.

Harvesting

Bitter gourd takes about 55–60 days from sowing to first harvest. Further pickings should be done at 3-day intervals as bitter gourd fruits mature very fast. Picking of the fruits at the right edible maturity stage depends on the kinds and varieties. Normally, the picking is done when the fruits are still tender and green so that the fruits do not turn yellow or yellowish orange during transport. Harvest in the morning and store the fruits under the shade. With good management, harvesting can last for 4–5 months.

The yield of bitter gourd varies according to the system of cultivation, variety, season, and several other

factors. With good management, bitter gourd can yield up to 30 t/ha even under organic condition.

Postharvest Handling and Storage

Bitter gourd fruits are temporarily stored under shade before packing and transporting. The fruits are graded according to size and color before they are packed in plastic bags or crates. They can be stored at 4 °C for 3 weeks. Do not mix organic produce with conventional harvests.

Seed Production

Bitter gourd is cross-pollinated. It bears separate male and female flowers. To control pollination, plant in isolation at 500–800 m away from the other varieties of ampalaya. If isolating the crop is difficult, do a controlled pollination. Wrap the unopened petals of the male and female flowers from selected plants the day before the flowers open using a 2 cm x 2 cm piece of aluminum foil. The following day, collect the male flowers and rub the anther to the stigma of the female flower. Put back the aluminum foil. Tag the pollinated flower with a piece of string or plastic label.

If the number of seeds of several relatively uniform varieties are to be increased, do sibbing instead of just selfing. Sibbing is pollination among the plants within the same line or variety (genetic make-up). But in selfing, pollination is done within the same plant. Bagged male flowers from all the plants in the same line/variety are bulked and are used to pollinate the bagged female flowers in the same line/variety.

Harvest pollinated fruits at full maturity. Store the fruits until fully yellow. Scoop out the seeds and place in a plastic container. Let stand overnight to allow fermentation to remove the mucilage on the seeds. Wash seeds the following day. Air-dry the washed seeds, then sun-dry to around 10% moisture content (MC). To determine if the MC is acceptable, put about ½ kg seeds inside a plastic bag and expose to sunlight.

If condensation occurs after 30 minutes, continue sun-drying the seeds. Pack the dry seeds in moisture-proof containers, label with the name of the variety and date of extraction then store in a cool, dry place. If properly stored, seeds can remain viable for up to 2 years. Small quantities of seeds can be stored in the refrigerator.

Cost and return analysis for one-season production of organic ampalaya*.

Items	Total Amount (P/ha)
A. Labor Cost (P250/MD; P500/MAD)	
Plowing (5 MAD)	2,500
Harrowing (3 MAD)	1,500
Furrowing/Bed preparation (5 MAD)	2,500
Organic fertilizer application (10 MD)	2,500
Mulching film application (10 MD)	2,500
Planting (3 MD)	750
Trellising (6 MD)	1,5000
Fertilizer: spraying with FPFS and Bio-pesticide (10 MD)	2,500
Irrigation (20 MD)	5,000
Hilling up (4 MD)	1,000
Weeding (10 MD)	2,500
Vine training (3 MD)	750
Harvesting (30 MD)	7,500
Miscellaneous (20 MD)	5,000
Sub-total	38,000
B. Materials	
Seeds (5 kg/ha)	18,750
Trellising materials	30,000
Organic fertilizer (2 t)	10,000
Mulching film (1.2 m x 400 m)	5,833
FPFS	2,500
Bio-pesticide	500
Net bags, crates, and knives	5,000
Miscellaneous	5,000
Sub-total	77,583
Sub-total (A+B)	115,583
C. Contingencies (15%)	17,337
Grand Total Cost (A+B+C)	132,920

Items	Total Amount (P/ha)
Gross Income (range) ^a	400,000–500,000
Net Income (range)	260,000–360,000
% ROI (range)	200–276%

* With marketable yield of 20–25 t/ha at farm gate price of P20/kg. Costs are based on 2013 prices; FPFS - fermented plant food supplement; MAD - man-animal days; MD - man-days

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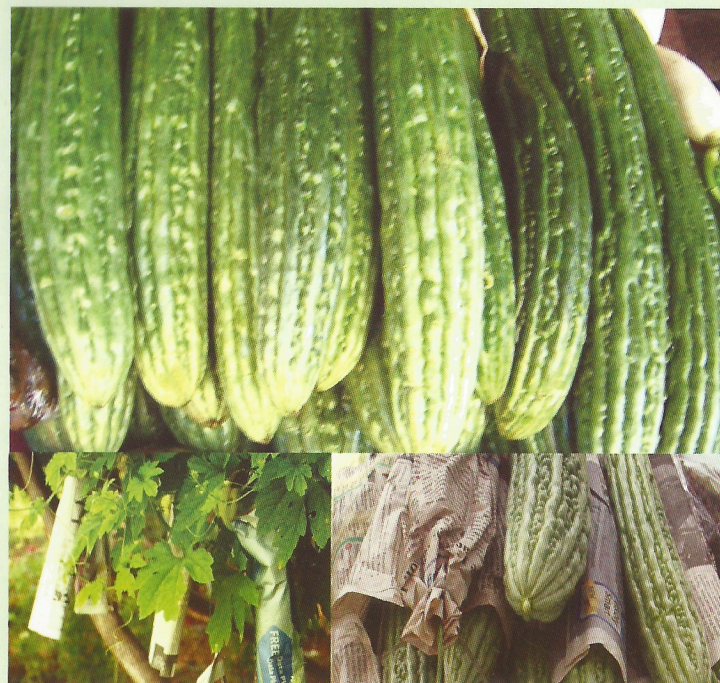
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