

- Powdery mildew Use resistant or tolerant varieties like Rizalina.
- Little leaf Remove nearby sources of inoculum such as other cucurbits (ampalaya, patola) with little leaf. Practice crop rotation.

Harvesting

Fruits can be harvested at different levels of maturity depending on market preference. In most cases, fruits are harvested just before they are fully ripe or when the peduncle starts to dry up. It is best to harvest the fruits with a portion of the peduncle attached to prolong storage life. Squash is harvested immature when it is to be cooked with the skin intact. Avoid cutting fruits from the vines if they cannot be marketed immediately. Handle the fruits with care to prevent bruising. Store under the shade.

Seed production

Select plants that are vigorous and are free of damage from pests and diseases at early flowering stage. Select fruit shape based on the undeveloped ovary of the female flower. If no other types or varieties are found around the area, manual pollination is not required. Selection can be done later when the fruits are already mature. Otherwise, manual pollination is required to ensure the development of true to type seed.

Squash is cross pollinated. It bears separate male and female flowers. Control pollination by wrapping the tip of the male and female flowers from selected plants the day before flower opening using a 4 cm x 4 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 indicating date of pollination.

Harvest pollinated fruits at full maturity. Store for 1–3 months before seed extraction. To extract seeds, cut the fruits in half. Select only fruits with thick flesh, deep orange color, and sticky sap. Scoop out the seeds from the selected fruits. Place inside a net bag and wash in water

to remove the film of flesh. Air dry first 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 place under the sun. 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 Per Hectare	
Items	Amount (P)
VARIABLE COSTS	
Labor (P220/man-day [MD])	
Clearing (10 MD)	2,200
Plowing (P800/tractor hr x 4 hrs)	3,200
Harrowing (P800/tractor hr x 2 hrs)	1,600
Furrowing (P350/man-animal-day [MAD])	350
Bed preparation (10 MD)	2,000
Manure/fertilizer application (5 MD)	1,000
Planting (2 MD)	400
Vine training/pruning (10 MD)	2,000

Sidedressing (6 MD)	1,200
Spraying (8 MD)	1,600
Weeding (10 MD)	2,000
Irrigation (10 MD)	2,000
Mulching (10 MD)	2,000
Harvesting (20 MD)	4,000
Miscellaneous (e.g., hauling, repairs, etc.) (10 MD)	2,000
Subtotal	27,550

Materials	
Seeds (3 kg)	4,500
Manure (60 bags)	4,800
Fertilizer	
- 14-14-14 (3 bags)	2,469
- 46-0-0 (2 bags)	1,942
- 0-0-60 (2 bags)	1,706
Insecticides (5 L)	2,000
Fuel and oil	4,000
Plastic mulch (6 rolls) (may be used up to 3 croppings)*	4,400
Miscellaneous (e.g., pail, gloves, etc.)	2,000
Subtotal	27,817

Interest on Production Loans at 21% per anum	6,300
Total (Variable Costs)	61,667

FIXED COSTS	
Land Rental	10,000
Depreciation	
Knap sack sprayer (1 unit)	500
Scythe (5 pcs)	83
Hoe (5 pcs)	417
Shovel (3 pcs)	320
Plastic drum (2 pcs)	533
Total (Fixed Costs)	11,853

TOTAL COSTS	73,520
Gross Income	
Regular season (at P5/kg with 20 t/ha yield)	100,000
Offseason (at P15/kg with 10 t/ha yield)	150,000
Net Income	
Regular season	26,480
Offseason	76,480

* 6 rolls x P2,200/roll = P13,200/3 croppings

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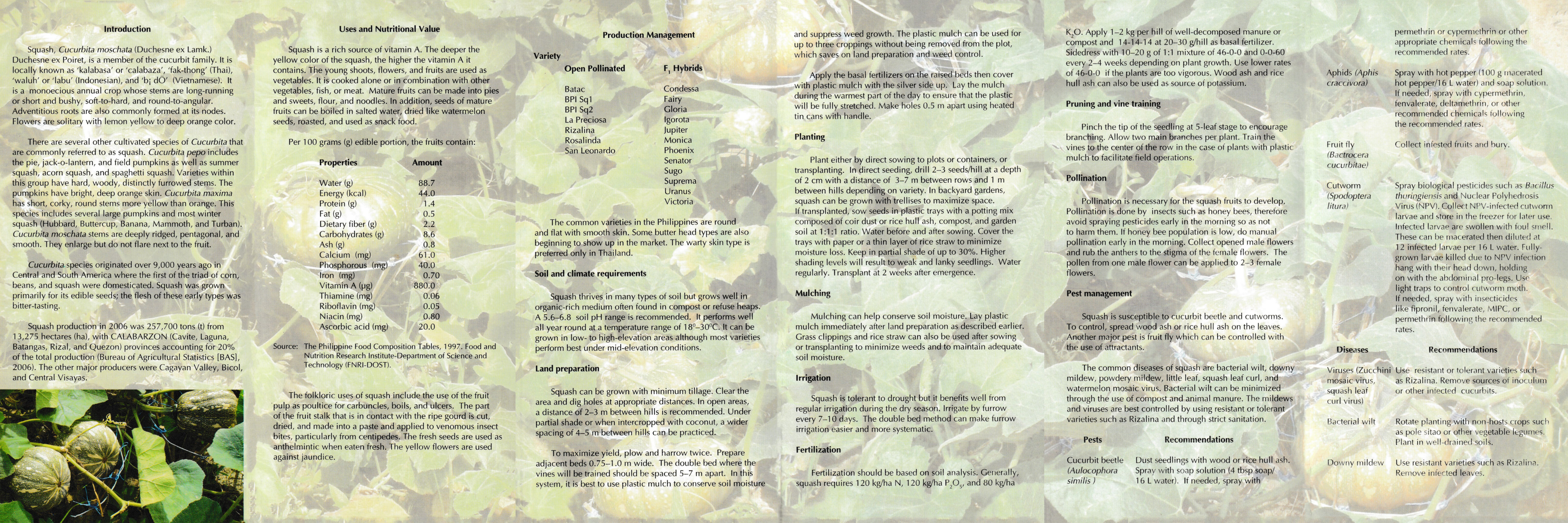
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Squash Production Guide





Introduction

Squash, *Cucurbita moschata* (Duchesne ex Lamk.) Duchesne ex Poiret, is a member of the cucurbit family. It is locally known as ‘kalabasa’ or ‘calabaza’, ‘fak-thong’ (Thai), ‘waluh’ or ‘labu’ (Indonesian), and ‘bı dÖ’ (Vietnamese). It is a monoecious annual crop whose stems are long-running or short and bushy, soft-to-hard, and round-to-angular. Adventitious roots are also commonly formed at its nodes. Flowers are solitary with lemon yellow to deep orange color.

There are several other cultivated species of *Cucurbita* that are commonly referred to as squash. *Cucurbita pepo* includes the pie, jack-o-lantern, and field pumpkins as well as summer squash, acorn squash, and spaghetti squash. Varieties within this group have hard, woody, distinctly furrowed stems. The pumpkins have bright, deep orange skin. *Cucurbita maxima* has short, corky, round stems more yellow than orange. This species includes several large pumpkins and most winter squash (Hubbard, Buttercup, Banana, Mammoth, and Turban). *Cucurbita moschata* stems are deeply ridged, pentagonal, and smooth. They enlarge but do not flare next to the fruit.

Cucurbita species originated over 9,000 years ago in Central and South America where the first of the triad of corn, beans, and squash were domesticated. Squash was grown primarily for its edible seeds; the flesh of these early types was bitter-tasting.

Squash production in 2006 was 257,700 tons (t) from 13,275 hectares (ha), with CALABARZON (Cavite, Laguna, Batangas, Rizal, and Quezon) provinces accounting for 20% of the total production (Bureau of Agricultural Statistics [BAS], 2006). The other major producers were Cagayan Valley, Bicol, and Central Visayas.

Uses and Nutritional Value

Squash is a rich source of vitamin A. The deeper the yellow color of the squash, the higher the vitamin A it contains. The young shoots, flowers, and fruits are used as vegetables. It is cooked alone or in combination with other vegetables, fish, or meat. Mature fruits can be made into pies and sweets, flour, and noodles. In addition, seeds of mature fruits can be boiled in salted water, dried like watermelon seeds, roasted, and used as snack food.

Per 100 grams (g) edible portion, the fruits contain:

Properties	Amount
Water (g)	88.7
Energy (kcal)	44.0
Protein (g)	1.4
Fat (g)	0.5
Dietary fiber (g)	2.2
Carbohydrates (g)	8.6
Ash (g)	0.8
Calcium (mg)	61.0
Phosphorous (mg)	40.0
Iron (mg)	0.70
Vitamin A (µg)	880.0
Thiamine (mg)	0.06
Riboflavin (mg)	0.05
Niacin (mg)	0.80
Ascorbic acid (mg)	20.0

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

The folkloric uses of squash include the use of the fruit pulp as poultice for carbuncles, boils, and ulcers. The part of the fruit stalk that is in contact with the ripe gourd is cut, dried, and made into a paste and applied to venomous insect bites, particularly from centipedes. The fresh seeds are used as anthelmintic when eaten fresh. The yellow flowers are used against jaundice.

Production Management	
Variety	
Open Pollinated	F ₁ Hybrids
Batac	Condessa
BPI Sq1	Fairy
BPI Sq2	Gloria
La Preciosa	Igorota
Rizalina	Jupiter
Rosalinda	Monica
San Leonardo	Phoenix
	Senator
	Sugo
	Suprema
	Uranus
	Victoria

The common varieties in the Philippines are round and flat with smooth skin. Some butter head types are also beginning to show up in the market. The warty skin type is preferred only in Thailand.

Soil and climate requirements

Squash thrives in many types of soil but grows well in organic-rich medium often found in compost or refuse heaps. A 5.6–6.8 soil pH range is recommended. It performs well all year round at a temperature range of 18°–30°C. It can be grown in low- to high-elevation areas although most varieties perform best under mid-elevation conditions.

Land preparation

Squash can be grown with minimum tillage. Clear the area and dig holes at appropriate distances. In open areas, a distance of 2–3 m between hills is recommended. Under partial shade or when intercropped with coconut, a wider spacing of 4–5 m between hills can be practiced.

To maximize yield, plow and harrow twice. Prepare adjacent beds 0.75–1.0 m wide. The double bed where the vines will be trained should be spaced 5–7 m apart. In this system, it is best to use plastic mulch to conserve soil moisture

and suppress weed growth. The plastic mulch can be used for up to three croppings without being removed from the plot, which saves on land preparation and weed control.

Apply the basal fertilizers on the raised beds then cover with plastic mulch with the silver side up. Lay the mulch during the warmest part of the day to ensure that the plastic will be fully stretched. Make holes 0.5 m apart using heated tin cans with handle.

Planting

Plant either by direct sowing to plots or containers, or transplanting. In direct seeding, drill 2–3 seeds/hill at a depth of 2 cm with a distance of 3–7 m between rows and 1 m between hills depending on variety. In backyard gardens, squash can be grown with trellises to maximize space. If transplanted, sow seeds in plastic trays with a potting mix composed of coir dust or rice hull ash, compost, and garden soil at 1:1:1 ratio. Water before and after sowing. Cover the trays with paper or a thin layer of rice straw to minimize moisture loss. Keep in partial shade of up to 30%. Higher shading levels will result to weak and lanky seedlings. Water regularly. Transplant at 2 weeks after emergence.

Mulching

Mulching can help conserve soil moisture. Lay plastic mulch immediately after land preparation as described earlier. Grass clippings and rice straw can also be used after sowing or transplanting to minimize weeds and to maintain adequate soil moisture.

Irrigation

Squash is tolerant to drought but it benefits well from regular irrigation during the dry season. Irrigate by furrow every 7–10 days. The double bed method can make furrow irrigation easier and more systematic.

Fertilization

Fertilization should be based on soil analysis. Generally, squash requires 120 kg/ha N, 120 kg/ha P₂O₅, and 80 kg/ha

K₂O. Apply 1–2 kg per hill of well-decomposed manure or compost and 14-14-14 at 20–30 g/hill as basal fertilizer. Sidedress with 10–20 g of 1:1 mixture of 46-0-0 and 0-0-60 every 2–4 weeks depending on plant growth. Use lower rates of 46-0-0 if the plants are too vigorous. Wood ash and rice hull ash can also be used as source of potassium.

Pruning and vine training

Pinch the tip of the seedling at 5-leaf stage to encourage branching. Allow two main branches per plant. Train the vines to the center of the row in the case of plants with plastic mulch to facilitate field operations.

Pollination

Pollination is necessary for the squash fruits to develop. Pollination is done by insects such as honey bees, therefore avoid spraying pesticides early in the morning so as not to harm them. If honey bee population is low, do manual pollination early in the morning. Collect opened male flowers and rub the anthers to the stigma of the female flowers. The pollen from one male flower can be applied to 2–3 female flowers.

Pest management

Squash is susceptible to cucurbit beetle and cutworms. To control, spread wood ash or rice hull ash on the leaves. Another major pest is fruit fly which can be controlled with the use of attractants.

The common diseases of squash are bacterial wilt, downy mildew, powdery mildew, little leaf, squash leaf curl, and watermelon mosaic virus. Bacterial wilt can be minimized through the use of compost and animal manure. The mildews and viruses are best controlled by using resistant or tolerant varieties such as Rizalina and through strict sanitation.

Pests	Recommendations
Cucurbit beetle (<i>Aulocophora similis</i>)	Dust seedlings with wood or rice hull ash. Spray with soap solution (4 tbsp soap/ 16 L water). If needed, spray with

permethrin or cypermethrin or other appropriate chemicals following the recommended rates.

Aphids (*Aphis craccivora*)

Spray with hot pepper (100 g macerated hot pepper/16 L water) and soap solution. If needed, spray with cypermethrin, fenvalerate, deltamethrin, or other recommended chemicals following the recommended rates.

Fruit fly (*Bactrocera cucurbitae*)

Collect infested fruits and bury.

Cutworm (*Spodoptera litura*)

Spray biological pesticides such as *Bacillus thuringiensis* and Nuclear Polyhedrosis Virus (NPV). Collect NPV-infected cutworm larvae and store in the freezer for later use. Infected larvae are swollen with foul smell. These can be macerated then diluted at 12 infected larvae per 16 L water. Fully-grown larvae killed due to NPV infection hang with their head down, holding on with the abdominal pro-legs. Use light traps to control cutworm moth. If needed, spray with insecticides like fipronil, fenvalerate, MIPC, or permethrin following the recommended rates.

Diseases	Recommendations
Viruses (Zucchini mosaic virus, squash leaf curl virus)	Use resistant or tolerant varieties such as Rizalina. Remove sources of inoculum or other infected cucurbits.
Bacterial wilt	Rotate planting with non-hosts crops such as pole sitao or other vegetable legumes. Plant in well-drained soils.
Downy mildew	Use resistant varieties such as Rizalina. Remove infected leaves.