Pest and disease management options in squash.

Pests	Recommendations
Cucurbit beetle (*Aulcophora similis)*	Dust seedlings with wood or rice hull ash. Spray with soap solution (4 tbsp soap/16 L water).
Aphids (*Aphis craccivora)*	Spray with hot pepper (100 g macerated hot pepper/16 L water) and soap solution.
Fruit fly *(Bactrocera cucurbitae)*	Collect infested fruits and bury. Use fruit fly attractant such as methyl eugenol with cue-lure.
Cutworm (*Spodoptera litura*)	Spray commercially available biological pesticides such as *Bacillus thuringiensis* 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. 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.
Diseases	**Recommendations**
Viruses (Zucchini mosaic virus, squash leaf curl virus)	Use resistant or tolerant varieties. Remove sources of inoculum or other infected cucurbits.
Bacterial wilt	Rotate planting with non-host crops such as pole sitao or other vegetable legumes. Plant in well-drained soils.
Downy mildew	Use Rizalina or other resistant varieties. Remove infected leaves.
Powdery mildew	Use Rizalina or other resistant or tolerant varieties.
Little leaf	Remove nearby sources of inoculum such as ampalaya, patola, and other cucurbits with little leaf. Practice crop rotation.

Harvesting

Fruits can be harvested at different levels of maturity depending on market preference. Harvest fruits 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. Harvest immature squash 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, artificial 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. To maintain variety's purity, an isolation distance of 800–1000 m from other squash lines is necessary. If isolation is not possible, controlled pollination can be done. Wrap/tie 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.

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. Fruits can be stored for 1–3 months before seed extraction. To extract seeds, cut the fruits in half. Select fruits with thick flesh, deep orange, 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 the flesh. Air-dry 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 under the 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 squash.

Items	Amount in Total (P/ha)
Variable Costs	
A. Labor (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
Fertilization: spraying with FPFS (10 MD)	2,500
Irrigation (20 MD)	5,000
Weeding (10 MD)	2,500
Harvesting (30 MD)	7,500
Miscellaneous (20 MD)	5,000
Sub-total	**34,750**
B. Materials	
Seeds (3 kg/ha)	6,000
Organic fertilizer (2 t)	10,000
Mulching film (1.2 x 400 m)	5,833
FPFS	2,500
Net bags, crates, and knives	5,000
Miscellaneous	5,000
Sub-total	**34,333**
Sub-total (A+B)	**69,083**
C. Contingencies (15%)	**10,362**
Grand Total Cost (A+B+C)	**79,445**
Gross Income (range)[a]	**250,000–300,000**
Net Income (range)	**170,000–220,000**
% ROI (range)	**214-277%**

[a]With marketable yield of 25–30 t/ha at farm gate price of P10/kg. Costs are based on 2013 prices.
FPFS - fermented plant food supplement
MAD - man-animal days
MD - man-days

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Organic Squash Production

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Introduction

Squash, *Cucurbita moschata* (Duch.) Duch. Ex Poir., is a member of the cucurbit family. It is locally known as 'kalabasa' or 'calabaza,' 'fak-thong' (Thai),'waluh' or 'labu' (Indonesia) and 'bị dỎ'(Vietnam). It is a monoecious annual crop with stems that 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.

Several cultivated species of *Cucurbita* are commonly referred to as squash. The stem of *Cucurbita moschata*, the common squash in the Philippines, is deeply ridged, pentagonal, and smooth. It enlarges but does not flare next to the fruit. *Cucurbita pepo* is the true pumpkin that 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 stem more yellow than orange. The species include several large pumpkins and most winter squash (Hubbard, Buttercup, Banana, Mammoth, and Turban).

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

Uses and Nutritional Value

Squash is a rich source of Vitamin A. The deeper its yellow color, the higher the Vitamin A content. 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. Seeds of mature fruits can be boiled in salted water, dried like watermelon seeds, roasted, and used as snack food.

Per 100-g edible portion, the fruit contains:

Nutrient	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
Phosphorus (mg)	40.0
Iron (mg)	0.7
Vitamin A (μg)	880.0
Thiamine (mg)	0.06
Riboflavin (mg)	0.05
Niacin (mg)	0.8
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

Some of the commercial varieties are very susceptible to cucurbit or squash beetle and viruses. Other varieties are not adapted to low elevation condition having been bred in cooler areas.

Variety

The common varieties in the Philippines are round and flat with smooth skin. Some Butterhead types are beginning to show up in the market. The warty skin type is preferred only in Thailand. Among the better varieties under organic conditions are Rizalina, Batac, and Sorsogon.

Some new potential varieties selected under the project 'Variety Development, On-farm Trials and Seed Production of Organic Vegetables in Southern Luzon' funded by DOST-PCAARRD are 1056, 1058, and 10128 for the flat round type and 10127 and 10129 for the long or kinakaw type.

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 soil pH range between 5.6 and 6.8 is recommended. It performs well all year round at a temperature range of 18–30 ºC. It can be grown in areas with low to high elevation, 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 beds where the vines will be trained should be spaced 5–7 m apart. In this system, it is best to use plastic mulch to retain soil moisture and suppress weed growth. The plastic mulch can be used for up to three croppings, which saves on land preparation and weed control activities.

In plastic mulching, roll out the film with the silver side up. Secure one end by covering it with soil. Roll out the film at about 1 m before the end of the plot. Pull the film without rolling out to ensure that the plastic is fully stretched. Cover the ends and the sides with soil instead of using bamboo clips. Make holes using heated tin cans 7–10 cm in diameter. The holes may be spaced at 30–50 cm between hills in a row near the canal area of the twin beds. Allow the weeds to grow along the alleys for pest, soil, and mulch management.

Apply organic 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 depending on variety and 1 m between hills. 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 under partial shade of up to 30%. Higher shading levels will result in weak and lanky seedlings. Water regularly. Transplant 2 weeks after emergence.

Mulching

Apply 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. Mulching can help conserve soil moisture. The double bed method can make furrow irrigation easier and more systematic.

Fertilization

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

Generally, squash requires 120 kg/ha N, 120 kg/ha P_2O_5, and 80 kg/ha K_2O. For organic production, applying 1 kg per hill of well-decomposed manure or compost can supply 50-60 kg/ha N. Apply the remaining requirements as sidedress. Manure tea and fermented plant juice (FPJ) can also be used as drench during the early vegetative stage.

To prepare manure tea, soak ¾ sack (30 kg) of dried cow or horse manure in a plastic drum with 180 L water. Soak for 5–7 days with frequent stirring. To prepare FPJ, mix three parts chopped plant shoots or banana trunk with one part raw sugar or molasses. Ferment the mixture for 5–7 days.

Dilute the FPJ or manure tea (1 part tea manure to 20–40 parts water). Drench the plots with the diluted solution or use it as foliar fertilizer. The rate and frequency of fertilization depend on the plants' vigor.

Pruning and Vine Training

Pinch the tip of the seedling at five-leaf stage to encourage branching. Allow two main branches per plant. Train the vines to the center of the row to facilitate field operations.

Pollination

Pollination is necessary for the squash fruits to develop. It is done by insects such as honey bees but pesticides harm them. If honey bee population is low, do manual pollination early in the morning. Collect opened male flowers and rub the anthers (the protrusion in the center topped by yellow powder-the pollen) to the stigma (center) of the female flowers. The pollen of one male flower can be applied to 2–3 female flowers.

Pest and Disease Management

Squash is very easy to grow organically but it is also susceptible to cucurbit beetle and cutworms. 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 like Rizalina and through strict sanitation.