The interaction of fertilizer levels and seed size influenced the cumulative percent of pods harvested during the first 30 days (Table 3). At the 1x fertilizer level, plants from medium seed size had a higher cumulative yield than plants from small and large seeds. With increasing fertilizer levels, the cumulative percent of pods harvested from large seeds also increased compared to small and medium size seeds. At the 2x fertilizer level, plants from large seeds had 79% cumulative green pod yield vs 60% for medium and 56% for small seeds.

Table 3. Influence of fertilizer level and seed size on cumulative percent of green pods harvested from 'Tpt-1' winged bean plants. Fall 1980.

<table>
<thead>
<tr>
<th>Fertilizer level</th>
<th>Seed size</th>
<th>Total harvested at period ending (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Nov. 14</td>
</tr>
<tr>
<td>1x</td>
<td>Small</td>
<td>19</td>
</tr>
<tr>
<td></td>
<td>Medium</td>
<td>28</td>
</tr>
<tr>
<td></td>
<td>Large</td>
<td>15</td>
</tr>
<tr>
<td>1.5x</td>
<td>Small</td>
<td>21</td>
</tr>
<tr>
<td></td>
<td>Medium</td>
<td>17</td>
</tr>
<tr>
<td></td>
<td>Large</td>
<td>19</td>
</tr>
<tr>
<td>2x</td>
<td>Small</td>
<td>9</td>
</tr>
<tr>
<td></td>
<td>Medium</td>
<td>10</td>
</tr>
<tr>
<td></td>
<td>Large</td>
<td>22</td>
</tr>
<tr>
<td>LSD 0.10</td>
<td></td>
<td>NS</td>
</tr>
</tbody>
</table>

*Note: LSD 0.10 for the effect of fertilizer level and seed size on cumulative percent of green pods harvested from 'Tpt-1' winged bean plants. Fall 1980.*

Elemental concentration in leaves and stems was not affected by fertilizer levels or seed size. The mean concentration of N, P, K, Ca and Mg on dry weight basis was 3.45, 0.25, 1.53, 1.40 and 0.46%, respectively.

Seedling growth and green pod yields increased with increasing seed size. Similar increase in seedling growth with large size seeds was reported for broccoli, beans (1, 9), lima beans (10), sweet corn (2), and lettuce (7, 8). Seedlings of the accession ‘Tpt-1’ from large seeds had a more vigorous growth in the seedling stage and a higher yield than plants from medium and small size seeds. Plants from larger seeds did not have an earlier blooming date since the ‘Tpt-1’ requires short daylength for blooming. Thus, growers using larger seeds could delay direct seeding or setting plants in the field by approximately 1 week, since plants from large seeds developed more rapidly and would have a higher early yield than plants grown from medium and small size seeds, especially with increasing fertilizer levels. Green pod yields in these experiments were below those reported earlier (4). The reason for the lower yield was the shorter growing season in the fall of 1980. During the last week of November, minimum temperatures were below 10°C (50°F) which reduced blooming and pod development. After December 12, minimum temperatures for 3 consecutive days were around 5-6°C (41-43°F) which killed the flowers on all of the plants and no more blooming was observed for the remainder of the season. Growers in west central Florida therefore cannot expect a long growing season for winged beans where temperatures often fall 5°C or below in early December, especially in the interior areas.

The Chayote, a Perennial, Climbing, Subtropical Vegetable

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Additional key words. Sechium edule.

Abstract. The chayote (Sechium edule Sw.), native to the highlands of southern Mexico and Central America, was an important food source in pre-Columbian times as far south as Peru and Brazil. It was early introduced into the West Indies and later to southern Europe, North Africa and the Old World tropics. In 1886, chayotes grown in the Azores were being exported to England. In the early 1920’s, the vine was being planted in the southern United States and in California. There have been several attempts on the part of the U. S. Department of Agriculture to popularize the chayote in North America. Varieties from Costa Rica, the West Indies and Algiers were grown at the Plant Introduction Garden at Brooksville, Fla. Nevertheless, only a few planters took up the crop. Except for the enthusiasm of one individual in Lake City, the chayote might have vanished from Florida. For some years, chayotes were imported into the U. S. from Cuba—42 tons in 1941. In recent times, the newly aroused “gourmet” appreciation of unusual foods, and the active demand on the part of Latin American residents of this country, have given the chayote another chance to appeal to American farmers. The fruit raised in Florida and California is selling readily. In 1978, 5 acres of chayotes near Homestead were more profitable to the grower than were cucumbers or tomatoes. Yields may amount to 50,000 fruits...
The chayote, *Sechium edule* Sw., is the sole member of its genus, belonging to the family Cucurbitaceae. While the Spanish name, chayote (pronounced shy-oh'-tay) has been widely adopted, other frequently employed vernacular names include chocho (Jamaica), choko (West Indies), chokol (Australia, New Zealand), chowchow (India), chote (Cuba), chayotl or chayutli (Mexico), chuchu, machucu, or xuxu (Brazil), chinta, chintla, or alconchas (Central America), cidrayota, huesquila (Colombia), guisquil, huiquil, chima or perula (Guatemala), christophine (French West Indies; Trinidad and Tobago), tallon, tallote, or tayote (Puerto Rico), pataste, patastilla (Honduras), vegetable pear (British West Indies), gayota (Peru), caíto (Portugal), pipimela (Madeira), mirliton or chouchou (Louisiana), mango squash (southern USA), and shosho (Africa).

**Description**

The plant is a fast-growing, herbaceous, perennial vine with tuberous, starchy roots, nearly cylindrical, oval or irregular, yellowish and fissured externally, whitish and succulent internally; and climbing, almost hairless, ribbed stems bearing coiled, 5- to 5-cleft tendrils. The stems may attain 30 to 50 ft (9 to 15 m) in length in one year. The leaves, on petioles 1½ to 6 inches (4 to 15 cm) long, vary from 5 to 10 inches (12.5 to 25 cm) in length and width; are heart-shaped at the base, ovate or triangular, with 2 to 5 pointed lobes; leathery, dark-green and rough above, light-green and rough-hairy beneath. Flowers, whitish- or yellowish-green, are small and 5-petaled; the male in racemes, the female solitary or in pairs; both sexes usually to 5,000 ft (1,500 m) elevations in Peru. These, however, “grew poorly, produced only a very few fruits and gradually disappeared”. Later, 2 plants on the Isle of Hope off Savannah, Georgia, “covered trellises nearly an acre in extent and bore over 1,500 fruits in one season.”

Nevertheless, in spite of much official propaganda including wide distribution of illustrated bulletins on growing and preparing the fruit for the table, only scattered planters took up the crop. Those who produced any quantity found the fruit could not be successfully marketed since it was virtually unknown and there was no demand. For a brief period, one grower managed to sell his crop under the nickname, “trellis squash”. Except for the enthusiasm of one individual in Lake City, the chayote might have vanished in Florida. Benjamin Groover (Fig. 2) began growing the chayote in 1936 and reprinting and distributing cultural literature and recipes at his own expense. He specialized in selling the sprouted fruits for planting (9). Because of his efforts, there are individuals throughout the state who have persisted in chayote-growing. For some years, chayotes were imported into the United States from Cuba; 42 tons in 1941. In recent times, the newly aroused “gourmet” appreciation of unusual foods has given the chayote another chance to appeal to American consumers and farmers.

**Origin and Distribution**

Native to the highlands of southern Mexico and Central America, and an important food source in pre-Columbian times as far south as Peru and Brazil, the chayote was early introduced into the West Indies (where it was common in Jamaica in 1689) and later to southern Europe, North Africa and the Old World tropics. In 1886, chayotes grown in the Azores were being exported to England. About the same time, the vine was being grown with great success by Chinese farmers in Malaya. In the early 1890s it was being planted in the South Atlantic and Gulf regions of the United States and in southern California.  

There have been various attempts on the part of the United States Department of Agriculture and private individuals to popularize the chayote in North America. Dr. David Fairchild, the renowned plant explorer, first saw the vine grown by a Frenchman in a suburb of New Orleans in 1895. Later he became acquainted with the fruit in Jamaica and in Madeira. His first plantings (2 vines) were on Cat Island in the Bahamas and he induced a cucumber grower in Jacksonville, Florida, to try the crop, but results were not encouraging. Varieties from Costa Rica, Jamaica, Guadeloupe, Puerto Rico, New Orleans and Algiers were obtained for experimental planting at the new federal Plant Introduction Garden at Brooksville, Florida. Interest was stimulated by Wilson Popenoe’s introduction of superior, rounder, smoother types (called “peruleros”) from 5,000 ft (1,500 m) elevations in Peru. These, however, “grew poorly, produced only a very few fruits and gradually disappeared”. Later, 2 plants on the Isle of Hope off Savannah, Georgia, “covered trellises nearly an acre in extent and bore over 1,500 fruits in one season.”

There is now an active demand on the part of the Latin American residents in the United States and the fruit raised in Florida and California is selling readily not only in ethnic markets but in popular "natural food" stores and some supermarkets. In 1978, 5 acres (2 ha) of chayotes near Homestead, Florida, were more profitable to the grower than were cucumbers or tomatoes.

The chayote is commonly grown and marketed in Mexico and Central America (particularly Guatemala and Costa Rica), is cultivated commercially on a large scale in northern India at elevations between 1,200 and 5,000 ft (365 and 1,500 m), and in coastal districts of Queensland, Australia, and New Zealand, as well as in Algeria for the London and Paris markets. It has long been a profitable crop in Italy, Sicily, Sardinia, Libya and the former Italian colonies of Eritrea and Somalia.

**Varieties**

In 1901, O. F. Cook, a United States Department of Agriculture specialist in tropical agriculture, described 5 types in Puerto Rican markets: 'Round White', 'Long White' (the type most widely grown in the United States and elsewhere outside of Central America, as it is considered the most hardy and vigorous), 'Pointed Green', 'Broad Green', and 'Oval Green' (4).

Broad, dark-green, nearly smooth types are common in Guatemalan markets. Popular cultivars in Florida are known as 'Monticello White' and 'Florida Green'. 'Smooth Green' is a leading cultivar in Queensland. There are no named cultivars in Brazil.

**Climatic Requirements**

While the chayote is often referred to as a tropical plant, it does not thrive in the lowlands of the tropics, succeeds best in the subtropics, can be grown as a perennial as far north as Charleston, South Carolina, and as an annual further north, providing frost arrives late in the year—in December, not in November. Where the ground freezes deeper than 1 or 2 in (2.5 or 5 cm), the stems are killed back in winter but, if well mulched, the root remains undamaged and sends up new shoots in spring. Only a few plants are found in home gardens in southern Victoria, Australia, because the chayote can be grown commercially only where there is a day-length of at least 12 hours, to permit flowering and fruit-setting. It should be sheltered from strong winds.

**Soil**

The chayote prefers a rich, well-drained soil, but has done well on oolitic limestone in southern Florida. It cannot stand water-logging. In wet locations, the chayote must be planted on mounds.

**Propagation**

The seed usually germinates inside the fully mature fruit and the new shoot emerges as the seed elongates and protrudes slightly at the apex of the fruit. It is customary to plant the whole fruit but some people remove the sprouted seed in order to keep the fruit for eating. The vine will grow from the seed alone but not as vigorously. Cuttings of young basal shoots may be used for propagation if sprouted fruits are not available, and if it is desired to reproduce a special cultivar, inasmuch as chayotes do not always come true from seed.

**Culture**

When planting the whole fruit, it is placed at an angle of 45° with the shoot downward and the narrow base protruding very slightly at the surface of the soil. If the shoot is longer than 5 in (12.5 cm) it should be cut back to 1 or 2 in (2.5 or 5 cm). Deep planting will cause the seed to rot. Some growers place 2 or 3 fruits in each hole or hill.

Good preparation of the individual hole (about 2 ft (0.6 m) deep and 3 ft (0.9 m) in length and width) is essential in home-garden planting. In large-scale farming, the entire field is ploughed, cultivated and leveled. In either case, fertilizer is worked into the soil and regular applications of fertilizer are necessary over the growing season. A mixture of peat moss, humus, composted manure and sand in the planting hole promotes good growth. In Australia, poultry manure is initially mixed with the soil at the rate of 1 bag per 50 sq ft (25 sq m) and every 4 to 6 weeks thereafter NPK 5: 6: 6 is applied at the rate of 1¼ oz per 11 sq ft (40 g/sq m) in circles 6 to 10 ft (2 to 3 m) wide around the base of each plant (10).

**Spacing**

The fruits should be planted 7 to 11.5 ft (2.5 to 3.5 m) apart in rows 11.5 ft (3.5 m) apart because the roots may spread 6 to 7 ft (1.8 to 2.1 m) in each direction.

**Support**

The vine needs a strong fence or trellis, or may be set at the base of a post in a shade house. The stems will ascend the pole and then spread out over the roof, finally completely covering it. Only the base of the stems can tolerate shade; the rest of the plant requires full sun. The vine increases in productivity with age, as the tubers develop in size, and therefore the trellis or other support should be sufficiently strong and durable to last 3 to 8 years in favorable situations. Trellises in Australia, 22 ft (6.7 m) wide at the base, 15 ft (4.6 m) wide at the top, may be 152 to 197 ft (40 to 60 m) long (10).

**Irrigation**

Ample moisture is essential for vigorous growth. In
Queensland, irrigation lines are laid on the ground under the long trellises. During dry seasons, a straw or other mulch is beneficial in conserving moisture, but it should be taken away when the rainy season begins (11).

Cropping and Yield

The vines cover the trellises in 3 to 5 months and then begin to bear the fruit crop. Only 28 to 32 days after flowering, the fruits are full grown and are picked for consumption when slightly immature, just before the seed enlarges and begins to protrude from the apex. After the first year, in most growing areas, farmers are able to secure 2 crops per year, a light crop from late spring to early summer and the main crop from fall to winter. Fruits for planting are left on the vine until they are fully mature and ready to sprout.

Yield varies from 75 to 600 fruits per vine and may amount to 50,000 fruits per acre (120,000/ha) in commercial fields. The fruits range in weight from 0.25 to 2 or 3 lbs (113.5 g to 1 or 1.4 kg). Yield will decline somewhat after the third year.

When the vines become thickly matted on the trellis, they should be cut back to a height of 3.3 to 5 ft (1 to 1.5 m) and fertilized to promote regrowth. In India, the vines are trimmed back after each harvest, new shoots appear within 2 weeks, and fruits are set within 2 months (19).

Keeping Quality and Storage

The chayote is very firm and keeps and ships well without special packing. It does not bruise easily and bruises do not decay. Oversupplies may be stored at temperatures between 48 and 51°F (9 and 11°C) and relative humidity of 90% for 6 weeks before they show signs of shriveling. Lower temperatures induce chilling injury evidenced by pitting and browning (8). In Mexico, the fruits are stored for long periods packed in dry sand. Humid conditions and poor ventilation will cause the fruits to sprout in prolonged transit or storage, rendering them unfit for market, though still suitable for consumption.

Guatemalan Indians pinch off the tips of the seeds of sprouted fruits and bury the fruits in the ground for sprouting may at first appear sound, but after a fortnight or so begin to decompose with anthracnose caused by the fungus Colletotrichum lagenarium.

In some parts of the southern United States, pocket gophers harm the roots and ground moles injure them by their tunneling activities hunting for worms and insects. Squirrels attack the fruits in Florida.

Food Uses

Fruit: Chayotes may be boiled whole, unpeeled, till soft (15 to 20 min), then cut in half lengthwise. The flesh is scooped out, mashed, mixed with minced meat, seafood, eggs or cheese, variously seasoned, put back into the skins, and the stuffed halves are then lightly baked.

For other purposes, smooth chayotes are usually cut into thick slices and peeled with a potato peeler before cooking. If the fruits are deeply furrowed, it is much easier and less wasteful to cut them into 3 or 4 pieces, boil until the flesh is soft, then pull off the tough skin, which will come right out of the furrows. The flesh, which is very mild in flavor, can then be simply sliced or diced, seasoned with salt, pepper and butter, and perhaps lime juice, and eaten, or more elaborately prepared with chopped onions and/or grated cheese, topped with bread crumbs and browned in an oven, or served with a cream or cheese sauce (Fig. 3). Some recipes call for a dressing of sour cream or tomato sauce.

Fig. 3. The mature seed of the chayote, ready to sprout, is removed before cooking. A young, tender seed is cut up and cooked with the flesh, which may be simply served with cream sauce and seasoning (Photo by Kendal and Julia Morton).

In France, chayote, cut in disks, serves as a substitute for artichoke hearts. Chayote halves after boiling and peeling may be partly scooped out and then filled with a salad mixture topped with nut meats.

A pudding is made of boiled chayote and egg custard, topped with meringue. Jamaicans also prepare a chayote, rice and custard pudding. Chayote flesh may be combined with pineapple or other tart fruits to make sauce or pie filling.

The peeled, raw flesh can be cooked with cinnamon, candied ginger, grated lemon rind and sugar to make jam, or may be combined with apples, onions, raisins, brown sugar, salt, chili pepper, and other spices to make chutney. In New Zealand, chayote, cauliflower and onions are pickled...
together. Half-grown chayotes 1 to 2 in (2.5 to 5 cm) thick may be preserved in the same manner as dill pickles, or they may be quartered and pickled with raisins, cloves, ginger, chilies, bay leaves and other ingredients (1, 4, 6, 7, 18, 20, 23).

Chayote flesh is suitable for use as an extender in almost any fruit or vegetable preserve. Gibberellin-induced seedless fruits are expected to be more desirable than seeded fruits for commercial processing (3).

**Seed:** If the fruits are picked at the preferred stage of maturity, the seed is only partially developed and tender and is not separated from the fruit. However, if the seed has been allowed to develop fully, it may be removed and cooked separately in butter and is relished for its agreeable nutlike flavor. In Jamaica, boiled seed is cooked with sugar as sweetmeats. In Indonesia. In Costa Rica, the boiled tuber is a standard food value.

**Root:** After the vine has been growing for 2 years, yamlike tubers (Fig. 4) up to 3 lbs (1.36 kg) in weight and of irregular form, may be dug up without destroying the vine (if done with care), peeled, boiled, fried or roasted and eaten like yams, or they may be cooked with sugar as sweetmeats. They are marketed in Mexico; considered a delicacy in Indonesia. In Costa Rica, the boiled tuber is a standard ingredient in the combination vegetable platter served at nearly every evening meal. In Australia the tubers are commonly fed to swine.

![Chayote Vine](https://example.com/chayote_vine.jpg)

**Food Value**

The following data represent the minimum and maximum values of various nutritional elements from analyses made in different countries, from the Philippines to Mexico, per 100 g of edible portion.

**Fruit:** Moisture, 88.8 to 95.1 g; fat, 0.12 to 0.47 g; crude fiber, 0.36 to 0.91 g; protein, 0.64 to 1.2 g; total carbohydrates, 4.4 to 8.62 g; nitrogen, 0.95 to 1.56 g; ash, 0.2 to 0.6 g; calcium, 6.1 to 19.0 mg; phosphorus, 15.0 to 36.0 mg; iron, 0.29 to 2.08 mg; carotene, 0.001 to 0.271 mg (or otherwise expressed as 6 I.U.); thiamine, 0.03 to 0.33 mg; riboflavin, 0.03 to 0.37 mg; niacin, 0.35 to 1.10 mg; ascorbic acid, 11.5 to 29.0 mg; nicotinic acid, 0.4 mg. Calories per kg: 471.

**Root:** Moisture, 69.8 to 84.5 g; fat, 0.05 to 0.39 g; crude fiber, 0.5 to 3.70 g; protein, 1.51 to 3.12 g; total carbohydrates, 23.99 to 26.08 g; nitrogen, 0.382 g; ash, 0.81 to 1.17 g; calcium, 6.1 to 17.50 mg; phosphorus, 34.3 to 75.0 mg; iron, 0.54 to 2.28 mg; carotene, 0.0 to 0.18 mg; thiamine, 0.041 to 0.088 mg; riboflavin, 0.05 to 0.028 mg; niacin, 0.780 to 1.04 mg; ascorbic acid, 17.50 to 25.70 mg.

**Vine** (young shoots): Moisture, 88.4 to 98.06 g; fat, 0.24 to 3.3 g; crude fiber, 0.8 to 1.4 g; protein, 1.11 g; total carbohydrates, 6.17 g; nitrogen, 0.490 to 0.778 g; ash, 0.29 to 1.32 g; calcium, 21.7 to 69.5 mg; phosphorus, 47.0 to 122.9 mg; iron, 1.39 to 8.17 mg; carotene, 4.560 µg (or otherwise expressed as 2.025 I.U.); thiamine, 0.043 to 0.119 mg; riboflavin, 0.124 to 0.508 mg; niacin, 0.919 to 1.190 mg; ascorbic acid, 10.5 to 33 mg; sodium, 1.4 mg; potassium, 310 mg. The leaves are reportedly rich in peroxidase.

**Irritant Factor**

Prolonged peeling of a quantity of chayote fruits may irritate the skin of the hands and even cause a sensation of numbness extending up the arms. This reaction can be avoided by wearing disposable plastic gloves.

**By-products**

**Vine:** The vine is readily grazed by livestock.

**Fiber:** Fiber extracted from old stems may be used for cordage and weaving. It has been employed in basketry. Under the trade name, paille chouchou, it was formerly exported from Reunion and used in Paris for making ladies’ hats (4).

**Honey:** The flowers are heavily visited by honeybees. Male and female flowers have 10 glands secreting nectar in abundance and some beekeepers believe the vine one of the best honey plants in the world.

**Medicinal Uses**

In Cuba, the tuber is regarded as a potent diuretic and remedy for pulmonary ailments. An emulsion of the seeds is given to relieve intestinal inflammation. In Yucatan, it is believed that the leaf decoction, taken several times daily, will lower blood pressure and dissolve urinary calculifications.
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