

Cucurbitaceae

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Scientific Classification

Cucurbitaceae is the major family name encompassing about 125 genera and 825 species.¹ Cucurbitaceae is divided into two sub-families: Zanonioideae and Cucurbitoideae. The sub-family Cucurbitoideae contains the food producing plants, and will be the subject of our study. Varieties of both pumpkin and squash fall under the species *Cucurbita pepo*, *Cucurbita maxima*, *Cucurbita moschata*, and *Cucurbita mixta*.² All cucumbers are of the species *Cucumis sativus*.³

Kingdom	Plantae
Phylum	Magnololphyta
Class	Magnoliopsida
Order	Cucurbitales
Family	Cucurbitaceae

Origins and Locations

Cucumbers originated in India and other parts of Western Asia.⁴ There are relatives of the cucumber that can be found in the foothills of the Himalaya Mountains, but cannot be used agriculturally because of bitter fruit, mainly dormant seeds and delayed maturity. Other relatives of the cucumber can be found in China and the Near and Middle East, however cucumbers were most likely domesticated in Asia.⁵ Cultivation of the vegetable as a food source began roughly 3000 years ago. From India, the cucumber was carried to Greece and Italy, where it played a pivotal role in the Roman Empire. From Rome, it spread to China and southern Russia. Literature suggests there was cultivation of cucumber in classical Rome by the first century. Spread to the rest of Europe by the Romans, the cucumber was later dispersed to the New World through colonialism and indigenous trade. The first records of cucumber cultivation were found in France in the 9th century, Great Britain in the 14th century, Caribbean by late 15th century and North America by mid 16th century.⁶ Cucumbers first arrived in the New World in Haiti (Hispaniola) by way of the Columbus and the Spanish in 1494. The crop spread up to Florida and then out to the Great Plains through Native American tribes.⁷ Native American tribes such as the Iroquois adopted the cucumbers into their gardens soon after their introduction to the continent.⁸ Domestic versions of the cucumber were first found in North America in the 19th century and include: Arlington White Spine, Boston Pickling and Chicago Pickling.⁹

The varieties of pumpkin and squash originated in various places throughout the Americas. Squash has its origins in the New World, specifically central Mexico, Peru and the Eastern side of the United States beginning 10,000 BCE. Native Americans cultivated squash heavily before European contact also; from trade and mixing, squash made its way to the Old World after Columbus' exploration after 1492.¹⁰

Cucurbita pepo is the earliest form of squash discovered. Remnants of it emerged in Florida in 10000 BCE, southern Mexico in 8000 BCE and in Illinois around 5000 BCE. Because of the noticeable change in seed size and other farming differences, researchers know that the *Cucurbita pepo* was being cultivated in southern and northern Mexico by at least 7500 BCE and in the Mississippi valley between 3000 and 1000 BCE. Cultivation from Mexico spread to the southwestern United States by 1000 BCE and by 1500 CE, varieties of the species were being farmed throughout the U.S. and all of Mexico.¹¹



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Pumpkins were brought to the Old World soon after the commencement of the first European explorations of the New World and are mentioned in early European works starting in 1536.¹³ Varieties of *Cucurbita pepo* have been found in European herbal records as long ago as 1542 CE. Varieties of *C. maxima* were also found in European herbals in 1591 CE. *C. moschata* reached Europe through Asia in 1688 CE.¹⁴ Pumpkins were cultivated in England in the mid sixteenth century, which is why English colonists were familiar with the crop prior to North American settlement.¹⁵

Cucurbita maxima originated and was domesticated in South America. It has a less wide spread history, primarily found on the coast of Peru, it was cultivated between 2500 BCE and 1500 BCE. Other remnants of *Cucurbita maxima* can be found in Argentina from 500 BCE and northern Chile in 600 CE, as well as Paraguay.¹⁶

Cucurbita moschata was discovered in southern Mexico around 5000 BCE and along the coast of Peru around 3000 BCE. South America is thought to be the secondary site of domestication. This species spread to northeastern Mexico by 1400 BCE and to the southwest U.S. by 900 CE. *Cucurbita moschata* made its way to the Gulf coast and Caribbean by way of early Spanish explorers. Crooknecks and cheese pumpkins, original to North America, were cultivated by colonists in the 1600s and variations can be found in India, southeastern Asia, Asia Minor and in Japan. By the 19th century *C. moschata* was established in northern Africa as well.¹⁷

Cucurbita mixta existed in Mexico and Central America before Columbus, and later spread to the rest of the American continent.¹⁸

Native American Influence

The Eastern Woodlands of the Americas combine the Northeast Great Lakes, Southeast United States: the Atlantic Coast west to the eastern prairies, north to Canada and south to the Gulf of Mexico. The Eastern Woodlands were personified by corn, beans and squash, all of which were from Mexico. The “Three Sisters” as they were classified by the Iroquois from Upstate New York, were the most important aspect of agriculture and diet for all nations of the Eastern Woodland area and those who lived in the Southwest. The three crops were grown together in an agriculturally symbiotic relationship. Each crop contributed beneficial factors that aided in the growth of the other two.¹⁹

The Iroquois led by Joseph Brant went North with the Loyalists at the end of the 18th Century and settled around Brantford, Ontario, Canada. There they formed the Six Nations – a highly agricultural Native American tribe. The three sisters were a staple in the Iroquois diet and helped increase the utilization of corn, squash and pumpkin in Ontario.²⁰



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Many varieties of squash coming from the New World to Europe had little trouble being establishing themselves. The Mesoamerican diet employed numerous different types of squashes in not only their diet, but in other aspects of dining, such as the making of utensils, flavoring, and sauces as well.²²

In the 1600s, the Wampanoags—a Native American tribe living in southeastern Massachusetts, Rhode Island, and modern day Cape Cod and Nantucket—grew many varieties of both squash and pumpkin (*Cucurbita pepo*). However, they were most likely domesticated in Mexico and eastern North America. When the Puritans came into contact with these tribes, they recognized the Native American squashes as the European

pompions colonists had adopted in the 15th century.²³ Similarly, the varieties of American seed in Tours, France were adopted from the Azores, and spread into Europe.²⁴

Physical Characteristics

As a family, cucurbits are herbaceous annuals or perennials with a storage root and mostly moist vines. The plants grow either prostrate along the ground or climb using tendrils.²⁵ They rarely grow as trees, shrubs or bushes. The tendrils can grow branched or simple and generated at the petiole base. There are usually four arched filaments coiling with an adhesive texture.²⁶ Leaves can range from simple to palmately compound. Those leaves that develop later are more deeply lobed and extra-floral nectaries are often found. The flowers are unisexual, so the plants are male or female, rarely hermaphroditic.²⁷



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In general, the flesh of cucurbitaceous fruit can range from fleshy, in the case of cucumbers, to dry, as with certain varieties of squash and pumpkin. The fruit of some members of the family will split open at maturity to release seeds, while others remain sealed and whole. The fruit can be pendulous, suspended from the plant, but due to size and weight, the some varieties of fruit are usually also resting on the ground. The fruit can contain anywhere from several to hundreds of seeds. The seeds may be adorned or colored, and some varieties contain edible and medicinal seed oil.²⁹ The outer layer of the fruit can range from a soft and/or leathery skin in cucumbers to dried and hard rind in mature squash and pumpkin.³⁰

The pumpkin plant has large, bristly leaves and large individual yellow flowers. The pumpkin fruit later develops from these flowers. The fruit is large, orange, round, and occasionally with greenish highlights and is attached to the plant by a woody stem. The exterior is notched with vertical grooves, and the interior contains stringy flesh filled with flat oval seeds.³¹ In terms of classification, squashes differ from pumpkins almost solely in shape. Rounder, wider members of the family are classified as pumpkins, while

the rest are squash. Some varieties of squash have necks, both straight and crooked, as well as a variety of colors, from bright yellow to dark green, and often combinations of these colors. The skin may be ridged, smooth, or covered in bumps. The stems are softer, rounder, and flare at the connection to the fruit.³² Cucumbers are long, cylindrical and green.³³



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Ecology

Cucurbits are mesophytic or xerophytic, mainly tropical or subtropical. They are distributed in both the eastern and western hemispheres relatively equally. Cucurbits are frost sensitive, annual, or perennial with tuberous storage roots. The typical pollinators are bees and moths. Less often, the rich nectar supply and pollen within the plant draws hummingbirds and bats. The UV-reflective petals direct the pollinators. The female flowers contain gynoecium that mimics the structure of the androecium in the male

flowers and can fool insects.³⁵



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Soil & Climate

Cucurbits should be grown in warm soil that is fertile and well irrigated. There needs to be room for the crop to set roots deep in the soil as well as space to expand on top of the soil also. The climate for large commercial production must be tropical or subtropical at the coldest because a slight frost will kill the young cucurbits very rapidly.^{37 38} The soil cannot be colder than 60 degrees Fahrenheit and should be between 65 and 75 degrees F for the most effective seed germination. Soil temperatures between 65 and 85 degrees F are ideal for maximum plant growth.³⁹

The roots of some of the larger cucurbits can penetrate 6 ½ feet down into the soil, so it is imperative to have well fertilized land with a lot of vertical and horizontal growing room. For planting, holes of at least 1½ feet deep by at least 2 feet wide are essential.⁴⁰ These holes then must be filled with good manure and compost mixed well with garden loam or a fertile and well-drained soil, containing clay, sand, and a significant amount of decomposed organic matter according to the GardenWeb Glossary of Botanical Terms.

The soil should also have a clay content of 15% to 30%, and can be mildly sandy. Heavier top soil commonly does not drain well, and stays too moist for too long which can cause the fruit to rot.⁴¹

When there is a high level of humidity, particularly in the later phases of growth, the chances of the cucurbit developing fungal disease are greatly increased. Conversely, extended cool and cloudy weather during the flowering growth period generally reduces bee activity, which in turn means there is poor pollination of flowers and fewer fruits on the crop.⁴²

Long days with a lot of sunlight generally increase the amount of staminate (male) flowers produced. Contrarily, shorter days with less light or less intense light will tend to increase growth of pistillate (female) flowers as well as leaf production. However, short days and high night temperatures augment the production of fruit.⁴³

Soil should have a pH no lower than 5 and anything below a pH of 5 should be limed.⁴⁴ There are some fertilizer requirements for cucurbits, however relative to other crops, there are not many. There is both a nitrogen and a phosphorous requisite, but most other fertilizing requirements such as potassium levels or areas with molybdenum deficiency purely depend on the specific soil and climate differences for the respective regions. The nitrogen requirement is about 70 kg to 100 kg per hectare (2.5 acres) and there must be at least 40 kg of phosphorous per hectare. Most of the time growers use 50 kg of phosphorus and 100 kg of potassium and 100 % is used at the time of planting whereas only two-thirds of the available nitrogen is applied at the time of planting. The left over nitrogen is then used approximately 3 to 4 weeks after the crop appears.⁴⁵

Cultivation of Cucurbits

Cucurbits are very frost sensitive, in colder climates the crop may need to begin growing indoors, in order to avoid any potential frost encounter. Even the weakest remnants of a frost will be tremendously detrimental to the cucurbit crop. If the cucurbits are grown indoors, the transplant must take place carefully, usually with the aid of peat pellets in order to reduce root damage and a high phosphorous solution should be generously sprayed to increase nutrient levels of the cucurbit because with all desired circumstances the cucurbit does not transplant well and if possible should be planted in situ. In colder climates, many gardeners use chitted seeds, or seeds that are soaked and begin germinating before they are sowed.

Crop	Spacing between plants in row	Spacing between rows	Planting Depth
Cucumber	12' indiv. Plants 24-36' btw. hills	48-72'	1'
Pumpkin	36-40'	72-96'	2-3'
Squash (bush)	24-30'	36'	2-3'
Squash (vine)	36-40'	72-96'	2-3'

The cucurbit plant thrives in warm, loamy soil that is rich with nutrients and moist but not oversaturated. The warmer the temperature, the faster the cucurbit seeds will germinate, between 75 and 95 degrees F will lead to maximum plant production. Cucurbits are generally in small hills, which should be five to six feet apart in all directions, about a foot and a half in diameter and minimally 12 inches deep.⁴⁷ The hills should be filled about 75 percent with loamy soil, manure and thoroughly mixed compost. Proceed to raise the hill approximately 5 to 6 inches above ground and half an inch deep.⁴⁸ Spring planting should not occur until after the last spring frost. Each hill should be planted with 4-5 seeds. Seeds should be planted beneath 1-3 inches of soil. Once the seeds are covered, lightly tamp down the soil, but not enough to form a crust over the seeds. Sandier, drier soil requires the seeds to be planted deeper than moister soil.⁴⁹ Once there is little to no danger of worm or bug infestation and the plants have 2-3 leaves, thin out the hills and the seeds. For each hill, remove all of the plants except for 1 or 2 of the largest and healthiest plants. Too many plants will crowd the hill. Cucurbit

plants require the maximum amount of sunlight possible.⁵⁰



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All vine crops benefit from higher levels of organic matter. For that reason, during the winter and fall before planting, one should use a cover crop and a prudent amount of mixed compost.⁵² Magnesium is very important to vine crops, so extra precautionary application of such items like Epsom salts is necessary if the soil lacks magnesium and has not been previously corrected from dolomitic limestone.⁵³

Cucurbits need an immense amount of heat, long days of light and a lot of moisture. They are also difficult to grow in small gardens because they need a great deal of space to spread. Site selection within a garden is therefore critical and the use of dwarf or bush cucurbits can be very helpful in maintaining a successful and diverse garden. Another method of containing cucurbit growth is by using a trellis and helping the vine climb on supports. In the early stages of development, the plant tends to spread quickly and far, but with a trellis, fence, or other vertical structure, their growth can be controlled and thus both the cucurbit and the rest of the crops in the garden will grow productively.⁵⁴

Summer squash and pickling cucumbers will produce edible fruit 48-56 days after planting. Winter squash and pumpkins yield the best quality if they are harvested after the vines have died from age or were killed by frost.⁵⁵

Nutrition and Uses

Cucurbits are a family of healthy foods. Cucumbers in particular are a prime dieting food. They are 96 percent water, with a little fiber and only a few calories. In addition, it provides a good source of vitamins A, K, and C, as well as a large amount of potassium. The National Cancer Institute has identified certain properties of the cucumber as having cancer preventative benefits.⁵⁶

Cucumbers are consumed either raw or pickled. Pickling is a common way to preserve the cucumber for longer periods of time. Historically, it allowed them to be available long after the normal growing season. Cucumbers are soaked in a solution of brine, vinegar and/or various spices. This preserves the cucumber, as well as imbuing it with different flavors.⁵⁷

Pumpkins provide a number of beneficial nutrients and minerals. They contain high levels of thiamin, niacin, vitamin B6, iron, magnesium and phosphorous. They have even higher levels of vitamin C, vitamin E, potassium, copper and manganese. In addition, the flesh of pumpkins is a very good source of dietary fiber. They are also low in saturated fat, cholesterol, and sodium. Pumpkins contain a very large amount of vitamin A, with one hundred grams of pumpkin flesh providing 148% of the percent Daily Value for the average diet.⁵⁸ Pumpkins are one of the best sources of carotenoids in human diet.⁵⁹ In plants carotenoids provide bright pigment to attract pollinators, as well as protect the outer layer of the plant in exposure to direct sunlight. In humans, not only do carotenoids help protect the skin and eyes from UV radiation, but they also aid in the production of detoxification enzymes, help protect the body from free radicals, and aid in modulating the immune response.⁶⁰ Among the types of carotenoids, two in particular provide strong health benefits: alpha and beta carotene. Beta carotene is a potent antioxidant and anti-inflammatory agent, while alpha carotene can help slow the effects of aging on the body.⁶¹

The seeds of a pumpkin contain additional sources of essential nutrients. Although they possess more fat, they make up for it with high levels of protein, magnesium and zinc.⁶² The seeds of pumpkin and squash function as teniafuges.⁶³ This means they are effective at paralyzing and eliminating intestinal parasites such as tapeworms and roundworms. This ability comes from a specific amino acid, cucurbitin, defined as (-)-3-amino-3-carboxypyrrolidine, which is found in varying levels in the seeds of many varieties of pumpkin and squash. When used for this purpose, the seeds can be ground up or brewed in tea. The size of each dose can range from 60 to 500 grams. Pumpkin seeds also help treat enlarged prostate glands in men.⁶⁴

As squash is a very similar in makeup to pumpkins, they share much of the same nutritional properties. The levels of nutrients shift according to the variety and maturity of the squash. Both potassium and vitamin A are much higher in the mature winter squashes than the immature summer squashes.⁶⁵

Squash and pumpkin can be prepared in a number of ways. The seeds are often baked for use as a nutritional snack. The flesh of pumpkins is often stringy, but works well in pies and soup. Historically, it was also used in combination with a variety of other foods, including beer, bread, pudding, and sauces.⁶⁶ Squash is divided into summer and winter categories, with summer referring to prematurely harvested squashes. Summer squashes are softer, and the skin and rind may be cooked and eaten with the

flesh. Due to the mature nature of the winter squash the skin and rind are too hard to be eaten. Only the cooked flesh of the winter squash is consumed.⁶⁷

Culture

One common use of pumpkins today is in association with the holiday Halloween. Historically, people in the British Isles would hollow out the inside of turnips, carve faces on a side, and place a lit candle inside to illuminate the image. These were called Jack-o'-lanterns, after an old myth. A thief named Jack tricked the Devil, who in turn cursed him and prevented him from entering Heaven or Hell upon death. Jack was forced to wander the earth with only a lit coal to light his way. Irish and Scottish immigrants brought the tradition to the Americas.⁶⁸ However, the carved vegetables in America were at first associated with the harvest season instead of Halloween. It wasn't until the 19th century that American Halloween adopted the tradition. In America, pumpkins were larger and more plentiful, becoming the vegetable of choice for Jack-o'-lantern carving.⁶⁹ Since then, the pumpkin has remained a symbol of both the harvest and Halloween. It has even become a form of artwork, with professional pumpkin carvers creating glowing images of people, landscapes, or highly detailed variations of traditional Halloween faces.⁷⁰



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<http://64.233.167.104/search?q=cache:7pmhgwEuauMJ:hortweb.cas.psu.edu/pubs/pdfs/veggies/cucurbits.pdf+growing+cucurbit&hl=en&ct=clnk&cd=1&gl=us&client=firefox-a>

⁵⁴ U.S.D.A., 189

⁵⁵ Gardening for Food and Fun. U.S. Department of Agriculture. 1977. Ppg. 187-90

⁵⁶ <http://www.answers.com/topic/cucumbers-melons-and-other-cucurbits>

⁵⁷ <http://www.answers.com/topic/cucumbers-melons-and-other-cucurbits>

⁵⁸ <http://www.nutritiondata.com/facts-C00001-01c20dL.html>

⁵⁹ http://www.herbs2000.com/herbs/herbs_pumpkin.htm

⁶⁰ http://www.herbs2000.com/herbs/herbs_pumpkin.htm

⁶¹ http://www.herbs2000.com/herbs/herbs_pumpkin.htm

⁶² <http://www.nutritiondata.com/facts-C00001-01c20dL.html>

⁶³ http://www.herbs2000.com/herbs/herbs_pumpkin.htm

⁶⁴ http://www.herbs2000.com/herbs/herbs_pumpkin.htm

⁶⁵ <http://www.nutritiondata.com/facts-C00001-01c20dL.html>

⁶⁶ <http://www.answers.com/topic/squash-and-gourds>

⁶⁷ <http://www.answers.com/topic/squash-and-gourds>

⁶⁸ <http://en.wikipedia.org/wiki/Jack-o'-lantern>

⁶⁹ <http://en.wikipedia.org/wiki/Jack-o'-lantern>

⁷⁰ <http://www.masterpiecepumpkins.com/>

⁷¹ Image Courtesy of Flickr: <http://www.flickr.com/photos/brothergrimm/1818852650/>