

## Capsicum



### Family Characteristics

The Solanaceae family, often called the ‘nightshades,’ is comprised of more than over two thousand species<sup>1</sup>. While there are obviously many variations within this family, their leaves are always arranged in an alternating pattern on the stem. Some other important family members include the poisonous henbane, flowering petunia, tobacco, eggplants and tomatoes. The genus name, capsicum, is presumably named so after the Latin word for a chest or box: *Capsa*.

### Historical importance and domestication

To date, the oldest known records of peppers come from the desert valley of Tehuanacán, 150 miles south of Mexico City. Studies of seeds and human coprolites found in ancient cave dwellings show that the indigenes were eating peppers as early as seven thousand B.C.<sup>2</sup> It is assumed that the first peppers consumed were picked from wild plants. While the actual date of domestication remains obscure, they were cultivated between roughly five thousand and three thousand B.C. Peppers were one of the first plants to be domesticated in the Americas, a fame is shared with *Phaseolus* beans (such as lime and pinto), corn, and cucurbits<sup>3</sup>. While the oldest records of peppers were found in Mexico, the nuclear area for early pepper domestication has been pinpointed to modern day central Bolivia, and five distinct species arose from further cultivation. *C. annum* was domesticated in an area ranging from Central America to as far north as the present day United States/Mexico border. *C. baccatum* was domesticated in a geographic band stretching across South America from Ecuador down through central Chile and across the bottom half of Brazil. *C. Chinense* and *C. frutescens* were domesticated commonly through out the upper half of South America as well as in Cuba, Puerto Rico, and the Virgin Islands. *C.*

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<sup>1</sup> Mills

<sup>2</sup> Andrews pg. 10

<sup>3</sup> Andrews pg. 18

*pubescens* occupied the smallest domesticated range, only including the Andes of Columbia, Ecuador, Peru and Bolivia. It has been surmised that these five species were domesticated independently of each other by different indigenes groups<sup>4</sup>. Despite the many variances in name, size and shape of peppers cultivars found in today's markets, they have all been derived from one of these five species.

Dr. Diego Alvarez Chanca, a physician on Columbus's fleet, gave the first written account of peppers of the West Indies in 1493. Every returning ship, laden with gold, silver, and pearls, carried many kinds of seeds back for monastery gardens in countries desperate for spices. Pedro Cieza de Leon (1519?-1560) returned with accounts of both the Peruvian Incas and the use of peppers, or *aji*, in the new world. In the same entry he writes of the cannibalistic murder of a Spaniard and of the high consumption of peppers. He tells how "the consumption of *aji* is greater than that of salt; for two thirds of their dishes it is used. It is sometimes eaten green and sometimes dried and pounded into spice"<sup>5</sup>. This only then begs the question: was the Spaniard spiced with chili peppers? Cannibalism aside, American capsicums were known in Spain by 1493, Italy by 1526, Germany by 1543 and the Balkans by 1569<sup>6</sup>.

The flood of pre-modern literature on the subject of peppers has come as both a blessing and a curse. While the menagerie of observations is helpful for setting a cultural context, a large percentage is contradictory to other documented observations, or just plain wrong. The term itself, pepper, was used indiscriminately when referring to peppers, black pepper, and cardamom. Various authors recognized as many and fifty species within the capsicum genus and as few as one. Early English colonists brought peppers with them to their new American settlements thereby being the means in which the genus was transferred from South to North America.

## Plant Biology

Peppers grown in temperate regions are herbaceous annuals but are herbaceous perennials when grown in regions where the temperature does not drop below freezing. Peppers are non climactic, meaning they do not produce ethylene and thus must stay on the vine to continue their ripening process<sup>7</sup>.

Root system: All peppers form a deep tap root (a straight tapering root which grows vertically down). The main, spindle, root will develop secondary fibrous (branching) root systems spreading laterally and downward to a depth of about thirty six to forty eight inches<sup>8</sup>.



Leaves: The leaves, typical to all Solanaceae plants are arranged alternately on the stem. Pepper leaves are simple, entire and asymmetrical.

Fruit: In colorations it ranges from the common green, yellow, orange and red to the rarer purple, white, and black. The fruit is green while it is still immature, and as the fruit matures it changes shade. The white and purple varieties however, show these colors as they develop and consequently do not have a

green immature stage. While many bell peppers are commercially consumed green, and thus immature, the mature (and more colorful) version peppers have higher quantities of vitamin C, A and calcium.

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<sup>4</sup> Pickersgill pg. 56

<sup>5</sup> Cieza de Leon pg 232

<sup>6</sup> Andrews pg. 5

<sup>7</sup> Mills

<sup>8</sup> Mills

Seeds: The seeds develop in clusters inside the fruit, attached to placenta veins or ‘ribs’ along the side of the fruit wall. A seed planted  $\frac{1}{4}$  to  $\frac{1}{2}$  of an inch deep in soil at least seventy five degrees is approximately ten days<sup>9</sup>.

## Horticulture

While peppers can be directly seeded or transplanted, direct seeding will only germinate if the soil is above seventy five degrees. Thus most peppers are started in greenhouses and transplanted to the field six to eight weeks later. While germinating the soil should be kept moist, and warmer soils will result in quicker germination and healthier plants. The seedling must also be given plenty of light. Too little sunlight results in tall, leggy (weak) plants<sup>10</sup>. Transplanting can only occur when all fear of frost has passed. The seedlings should be ‘hardened off’ before transplanting. This involves lowering the temperature of the seedling pots ten to fifteen degrees and reducing watering frequency to get the plants ready for life in the great outdoors. After transplanting, peppers must be watered regularly to avoid physiological disorders that may develop if watering is too sporadic. The three most crucial times to irrigate pepper plants is during their root establishment, and during its flower and fruit set. If not, the plant’s flowers will be aborted<sup>11</sup>.

Once ready for harvest, the plants must be harvested by hand due to the sensitivity of the fruit. They are ready for harvest once the fruit is shiny, firm, and will return to its original shape after being squeezed slightly. As peppers reproduce in cycles, new fruit will form begin to form after the first harvest. Once picked, the peppers should be cooled quickly to remove the ‘field heat’ which can greatly reduce their shelf life. They should also be kept away from other produce which emits ethylene (fruits and vegetables which will continue to ripen after being picked) as this will over ripen the pepper.

## Pests and Disease



Bell Peppers should not be planted with other member of the Solanaceae family as they are susceptible to the same pests and diseases and may transmit them more readily when close. Some of these are as follows.

### Diseases:

Tobacco mosaic virus (TMV) is one of the most common and widespread of all the plant viruses. TMV causes the leaves to become extremely distorted and ‘mottled’ resulting in stunted growth and malformed fruit. This virus infects numerous plant species, including vegetables and weed species such as mustards, nightshades, and jimson weed. TMV persists and remains infectious for many years in dried crop debris, and is also readily transmitted by mechanical means, such as hands, cutting tools and other equipment--another factor that contributes to its success<sup>12</sup>.

Phytophthora wilt (*Phytophthora capsici*) also called



<sup>9</sup> Mills

<sup>10</sup> Readers Digest pg. 88

<sup>11</sup> Andrews pg. 92

<sup>12</sup> Goldberg

"chili wilt," is caused by the soil-borne fungus, *Phytophthora capsici*. This fungus is a serious pathogen on peppers worldwide, but the disease is particularly widespread in furrow-irrigated fields in the U.S.<sup>13</sup>. This fungus causes a problem when soils are excessively wet, either from over-irrigation, heavy rains, or both<sup>14</sup>. In addition, pepper plants grown next to tall trees, fences or buildings may become diseased due to shading which causes high humidity and slow drying, favoring

Blossom-End Rot is a fruit disorder associated with inconsistent watering and a calcium deficiency. Other factors contributing to the occurrence of disease include root pruning, excessive soil salinity, and heavy applications of nitrogen fertilizers<sup>15</sup>. The disease typically first appears as a small, water-soaked, light-brown spot on the blossom end of immature fruit. As the diseased area enlarges the infected area becomes sunken and the fruit becomes leathery in appearance.

Insects: Aphids, flea beetles, cutworms, thrips, whitefly.

The most common diseases associated with pepper cultivation are, however, abiotic disorders such as blossom end rot.

### Some Like it hot?

All 'hot' peppers contain capsaicinoids, natural substances that produce a burning sensation in the mouth and throat. Capsaicinoids have no flavor or odor, but act directly on the pain receptors in the mouth and



Pure capsaicin powder. Sold under the name "16 Million

throat. Capsaicinoids are found primarily in the pepper's placenta, the white "ribs" that run down the middle and along the sides of a pepper<sup>16</sup>. Since the seed clusters are in such close contact with the ribs, they are also often hot as well. In the rest of the vegetable, capsaicinoids are unevenly distributed throughout the flesh, and it is likely that different parts of the same pepper may be hotter or milder than each other. The primary capsaicinoid, capsaicin, is so hot that a single drop diluted in 100,000 drops of water will still produce blisters on the tongue. Capsaicinoid content is measured in parts per million. These parts per million are converted into Scoville heat units, the industry standard for measuring a pepper's heat, as one part per million is equivalent to 15 Scoville units<sup>17</sup>. Bell peppers have a value of zero Scoville units, Cayenne's register from thirty to fifty thousands units, and habaneros, one of the hottest peppers, register 200,000 to 300,000. If you are serious about looking for some heat though, pure capsaicin has a Scoville heat unit score of 16 million, and is so powerful that chemists who handle the crystalline powder must work in a filtered "tox room" while wearing full body

protection<sup>18</sup>

### Early American Pepper Folklore and Popularity

<sup>13</sup> Goldberg

<sup>14</sup> Goldberg

<sup>15</sup> Goldberg

<sup>16</sup> Margen, pg. 140

<sup>17</sup> Margen, pg. 141

<sup>18</sup> Dewtiit, pg. 57

While the ‘bite’ of peppers had been accepted and celebrated in its place of origin, the fact that Anglo-Americans and Europeans enjoyed an relatively “cool” diet consigned hot peppers to mostly pharmacological rather than gustatory uses<sup>19</sup>. Cookery aside however, they played a role in nineteenth-century homeopathic medicine. Hot peppers were especially popular as things that tasted ‘bad’ or ‘burned’ as they were going down clearly advertised their medicinal virtue<sup>20</sup>. The Cayenne pepper was specifically exploited by homeopathic doctors who found its pungency a handy stimulant. Most of these recipes appear more heroic than homeopathic as they commonly included a tea made from cayenne pepper such as this cough remedy from the early nineteenth century: “take cayenne, one tea-spoonful; common salt, two tea-spoonfuls; one teacup of vinegar and water, and bring to a boil. Once cool, strain and gargle for an excellent remedy”<sup>21</sup>.

While Bells, with their low Scoville rating dominated American gardens as a token of summer opulence, hot peppers did not began to spice up the common American diet until the 1930s<sup>22</sup>. Sarah Gibbs Campbell, writing for *Ladies Home Journal* in 1931 assured readers of the splendors of spice in her column ‘Foreign Cookery: Recipes from Mexico and the Southwest’<sup>23</sup>. These recipes, tamed down for American tastes, opened the door for American housewives to add a dash of ‘exotic’ pungency to their meals. Since then, peppers (especially the ‘hots’) have constantly gained popularity. Today, hot peppers hold a cult-ish following.

## Cayenne



This pre-Columbian cultivator is thought to have originated in the South American country of French Guiana, and be named after the Cayenne River<sup>24</sup>. The Cayenne group, often plainly called chili or finger peppers, is characterized by long curved pods ranging from 4 to 12 inches. Its pungency is so great that many recipes calling for its use suggest removing the peppers ribs and seeds to decrease spiciness. Cayenne peppers, when dried and ground into a powder, make up the generic “red pepper” of super market spice isles.

## Bell

Out of the 111 different sweet cultivars of sweet peppers (found in fifty three seed catalogues), eighty three are various Bells<sup>25</sup>. Bell peppers contain a recessive



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<sup>19</sup> Wilson, pg. 91

<sup>20</sup> Wilson, pg. 92

<sup>21</sup> Wilson, pg. 92

<sup>22</sup> Wilson, pg. 95

<sup>23</sup> Wilson, pg. 103

<sup>24</sup> Andrews, pg. 96

<sup>25</sup> Andrews, pg. 92

gene that prevents capsaicin from being produced, thus leaving them lacking in spiciness. Bells are sweet, thick-fleshed fruits used primarily as a vegetable, although dehydrated flakes are available for seasoning. Bell peppers can be green, red, orange, yellow, and more rarely, white or purple depending on when they are harvested and the specific kind of cultivar. Green peppers are unripe bells, and while ripe, the pepper color depends on the type of cultivar<sup>26</sup>. Due to the fact that they are unripe, green bells have a slightly more bitter taste than red, orange, yellow, purple or white bells.

## **Culinary and Medicinal Uses**

In the culinary world peppers are used as both a vegetable and a spice. The growth in consumption after WWII can be directly correlated to American occupation during the war. The local people watched and tasted as American G.I.s poured their favorite condiments, catsup and hot sauce on all their favorite foods. Today the largest manufacturer of processed pepper products report that their largest foreign customers are Japan and Germany. The unprocessed fruit is usually either consumed raw, stuffed, roasted (my personal favorite), or chopped and pureed into various soups and sauces.

Medicinally, most attention is given to hot peppers. Bells, like their spicier counterparts, share the spotlight as being extremely rich in vitamin C (more than twice that of citrus - twenty one to thirty four mg per every ml of fruit). While the scientific understanding of our bodies need for vitamin C is relatively recent, the colloquial understanding is not. The pre-Columbian indigenes consumed vitamin C rich peppers at every meal. Mayans of Mesoamerica held ascorbic acid (vitamin C) rich peppers in their mouth to cure gum infections<sup>27</sup>.

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<sup>26</sup> Andrews, pg. 92

<sup>27</sup> Andrews pg. 8

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# Melons

## Scientific classification and etymology

Kingdom: Plantae

Division: [Magnoliophyta](#) Melons are a member of the vine-crop Cucurbitaceae family. This family of flowering plants also includes squash, pumpkin, gourds and cucumber. Cucurbitaceae is Latin for "to commit adultery"—melons are so named because of their tendency to interbreed, which makes classification of the fruit difficult. Two major crop species within the family are the melon (*Cucumis melo*) and the watermelon (*Citrullus lanatus*). One variety of melon, the Cantaloupe, derives its name from Cantalupo, a papal garden outside of Rome where the variety developed during the Renaissance. The melon recognized today as a cantaloupe derives from the muskmelon (*Cucumis melo* var. *reticulatus*).<sup>[1]</sup> Muskmelon's name derives from the Persian word musk, for a perfume, describing the sweet fragrance of the fruit.<sup>[2]</sup>

## History and Domestication

The oldest supposed record of domesticated melon dates back to an Egyptian illustration of funerary offerings from about six thousand years ago. Archeological remains however, place them in India much earlier – during prehistoric times – and unidentified melons, thought to be ancestors of the muskmelon, were being cultivated in the Indus valley about four thousand years ago (Cambridge world history, pg 1813). This gives India claim to be the cradle of melons; however it is likely that other melons arose elsewhere as well. Although truly wild forms of *C. melo* have not been found, several related wild species have been noted in those regions. The major changes made to melons during domestication by breeders have been to tease out disease resistance, remove seed dormancy, increase fruit size as well as the size of the mesocarp (the edible portion of the fruit), reduce the frequency of defects and increase the sugar content. The Ancients appear to have known the fruit in the 3d century B.C., and in the first century A.D. it was described by the Roman philosopher Pliny, though not enthusiastically. The melon at this time was still thought of as a green vegetable, and not a very good one at that, unless they were cooked and eaten with plenty of spices (Cambridge world history, pg 1813). Roman writers of the third century gave directions for growing it and more importantly preparing it with spices for eating. A Spanish writer of 1513 recognized the extremes of quality commonly found in the fruits and said: "If it is bad, it is a bad thing, we are wont to say that the good are like good women, and the bad like bad women." (melons started in Persia website) It is this capricious cultivation that retarded the spread of these fruits. Despite the unenthusiastic Roman pallets, the melon was spread throughout their empire. Real enthusiasm for the fruit was not expressed until the fifteenth century when they became popular in the French court. By then sweet melons had developed and were introduced to the Europe by the Moors in Granada.

The Chinese apparently did not know the muskmelon until it was introduced to their country around the beginning of the Christian Era from the regions west of the Himalayas. Columbus carried melon seeds on his second voyage and had them planted on Isabella Island in 1494. Melons were reported growing in New Mexico by 1540. Muskmelons were grown in the first Virginia and Massachusetts colonies and by the 17th century it was popular across New England.

### 19th Century

Watermelon was a staple of Thomas Jefferson's famous garden at Monticello, and the fruit was also cultivated by Henry David Thoreau in his Concord, MA garden. <sup>[3]</sup> Mark Twain wrote in his *Pudd'n'head Wilson*, "The true southern watermelon is a boon apart and not to be mentioned



with common things. It is chief of the world's luxuries, king by the grace of God over all the fruits of the earth. When one has tasted it, he knows what the angels eat." [4]

## Nutrition

Melons are a good source of Vitamin A, Vitamin C, and potassium. Their high water content (about 90%) renders them relatively low in calories.[5] They contain sugars and fiber, however they are both fat and cholesterol free. Orange-colored melons contain carotenes, and muskmelon has the highest beta-carotene content in the melon family.[6] The red flesh of watermelon contains lycopene, an anticarcinogen also found in tomatoes, grapefruit and guava (though highest in content in watermelon), that's believed to reduce the risk of many cancers, including prostate, stomach and pancreas. [7]

## Cultural aspects

Cucurbits have a historical association with sex and sexuality, fertility, abundance and gluttony. [8] In colder European climates, melons became a symbol of wealth, because "historically they were seasonal, expensive and scarce, with all the symbolic development that a commodity with such characteristics usually goes through." [9] The fruit also has a significant place in many non-Western traditions. "In Burmese and Laotian mythology, the creation of man started from a cucurbit." [10] In Japan, specialty melons grown in greenhouses are still used for gifts.[11] Chinese medicine frequently uses the fruit, root, or seed as treatments for a range of health concerns.[12] The fruit are used by some African farmers to feed cattle[13]



Though melon "does not lend itself to culinary extravagance," it is "nutritious, inexpensive, and easy-to-serve...truly ideal fare for summer holiday menus." [14] In the United States, the watermelon has become an icon of spring and summer, used in a decoration style called "Americana," symbolizing homeyness and the carefree nature of the warmer seasons. The fruit is associated with the American holiday celebrations of Memorial Day, the Fourth of July, and Labor Day. Patricia A. Turner suggests: "Given the American predisposition toward anything and everything big, we may find that the watermelon will emerge as the quintessential symbolic fruit for the nation." [15] Popular games involving the watermelon are often part of American picnics, such as eating contests, seed-spitting contests, and greased watermelons, which will float in a lake.[16]

## Culinary

Melons are most often eaten fresh, uncooked, and without adornment. The fruit can be sliced, cut into chunks, or juiced. Popular in fruit salads, melon balls are one attractive presentation option in preparing the fruit. Melons are used in various ethnic cooking, including an Asian preparation of cooked or pickled melon, an Indian preparation of roasted seeds, or an African likeness for dried and ground melon seeds. [17]

## Varieties

Cantaloupe, honeydew and watermelon are the most well-known varieties of melon. Cantaloupe is a type of a muskmelon, with orange flesh and khaki netted colored skin. Honeydew is considered the sweetest of all the melons. It averages five to six pounds, and its appearance is a



creamy yellow rind when ripe, and pale green flesh. There are more than 50 varieties of watermelon. While most varieties have red flesh, there are many orange and yellow-fleshed varieties as well. Throughout the United States, there are four general categories of watermelons containing the fifty varieties: Allsweet (20–25 pounds, with red flesh, an oblong shape, and a dark green rind, with or without stripes); Ice-Box (5–15 pounds, with red or yellow flesh, a round shape,

and a dark or light green rind); Seedless (10–25 pounds, with a red or yellow flesh, oval to round shape, and a light green rind with dark green stripes); Yellow Flesh (10–30 pounds, with a yellow to bright orange flesh, oblong to long shape, and light green rind with mottled stripes). [18]

Other varieties include: Casaba—a large melon with a pale yellow rind, white flesh and sweet taste, and unlike other melons, the casaba does not have an aroma; Persian—a melon similar to the Cantaloupe, but is slightly larger in size, has a greener rind, and a finer netting on the outside; Crenshaw—a melon weighing up to ten pounds, with a unique sweet and spicy flavor, with a yellowish skin and salmon colored flesh, a result of a cross between the casaba and Persian melon; Santa Claus—also called the Christmas melon because it peaks during the month of December, this melon is similar to the watermelon with the green and gold stripes, but is about a foot long and isn't as sweet as the other melons; and Sharlyn—a melon with a sweet taste like a cantaloupe and honeydew combined, with a netted outer layer, greenish-orange rind, and white flesh.[19]

## Cultivation

Light: Sunny.

Soil: Well-drained with moderate organic matter; sandy.

Fertility: Medium

pH: 6.0 to 7.5

Temp: Hot (70 to 85° F).

Moisture: Average

Planting: Seed after all danger of frost is past and when soil warms. Begin transplants in peat pots 3 to 4 weeks before this time.

Spacing: 24 to 36 inches by 5 to 7 feet for muskmelon hills; 6 to 8 feet apart for watermelon hills.

Hardiness: Very tender annual.

Common Cultural Problems: Poor flavor and lack of sweetness due to poor fertility, picking melons unripe, low potassium, magnesium or boron. Poor growth due to cool temperatures, wet weather, poorly adapted variety, loss of leaves from disease. Poor pollination caused by wet, cool

weather, lack of bee pollinators, and planting too close resulting in excessive vegetative growth. A heavy rain when melons are ripening may cause some of the fruit to split open. Fruit in contact with soil may develop rotten spots or be damaged by insects on the bottom. Place a board or a couple inches of light mulching material such as sawdust or straw, beneath each fruit when it is nearly full-sized. Placing newly developing fruit on a buried tin can with the ends cut out will



promote ripening.

Days to Maturity: 70 to 130 days.

Harvest: Muskmelons are harvested at full-slip; i.e., when the stem separates easily at the point of attachment.

Honeydew, Crenshaw, and Casaba melons are cut off after they turn completely yellow.

These melons will rot if left on the ground for too long. For water melons, become familiar with the variety being grown to determine the best stage for harvesting. The best

indicator is a yellowish color on the underside where the melon touches the ground. A dead tendril or curl near the point where the fruit is attached to the vine is used by some as an indicator that the fruit is ready for harvest. You may also thump the fruit, listening for the dull sound of ripe fruit, rather than a more metallic sound; however, this technique takes practice, and if you have just a few fruit, it is wise to include all of the above when making your decision.

## Pests and Diseases

Infectious diseases of muskmelon are caused by fungi, bacteria, and viruses, some of which are transferred by insects. Pests such as the cucumber beetle, and melon aphid are important to watch for, as they not only cause their own damage, but also transmit a host of fungal, bacterial and viral diseases. Fusarium wilt, Downy and powdery mildew, and other foliar diseases such as Cucumber mosaic virus, are the most important melon diseases to watch for.[20]

**Striped and Spotted Cucumber Beetles** - Striped cucumber beetles, *Acalymma vittata*, and spotted cucumber beetles, *Diabrotica undecimpunctata howardi*, are important insect pests of muskmelon and related crops in the mid-Atlantic area. They cause direct feeding damage to plants and also vector bacterial wilt, a serious annual disease of muskmelon. The beetles winter in woodlands and move onto young plants after transplanting. As our garden will be near the Rogers Glen, cucumber beetles are especially important to watch out for.

**Melon Aphids** - Aphids attacks plants throughout the growing season, but damage is usually worst in May and June. They are found on the underside of the melon leaves, where they suck sap from the plant and cause a reduction in the quality and quantity of the fruit.[21] Infested leaves curl downward and may turn brown and die. In addition to feeding damage, the dewy excretion of the aphids can cover the leaves and fruit and facilitate a moldy rot. Most importantly however,

Aphids commonly transmit other damaging infections to muskmelons and should be kept at bay with additions of ladybugs.

Fusarium wilt – *Erwinia stewartii*, the bacterium that causes bacterial wilt, overwinters in the digestive tract of cucumber beetles (primarily the striped varieties) and is transmitted by beetles feeding on the leaves.[22] The disease is characterized by wilting and dying of individual leaves and spreads to wilt the leaves on the entire plant. Eventually, the plant on the whole wilts and usually dies. Fruit produced by an infected plant is unsuitable for consumption.[23] If wilt is found on a plant, the plant should be dug up and removed from the garden to prevent the spread of infection.

Downy and powdery mildew – Powdery mildew, caused by the fungus *Podosphaera xanthii* and to a lesser extent by *Erisiphe cichoracearum*, occurs on all cucurbits. High temperatures promote the development of the disease, and it consequently occurs in the later summer months, from mid-July to the end of the growing season. A powdery white growth first appears as spots on the crown leaves and younger stems. Symptoms appear first on the crown leaves. As the infestation spreads it can cause rapid defoliation, a reduction in yield, and poor quality fruit with reduced sugar content.

Downy mildew is caused by the fungus *Pseudoperonospora cubensis*. [24] It is characterized in its infant stages by irregular yellowish to brown spots on the underside of the leaves. This disease generally does not occur in the Northeast before mid-August, however, when it becomes established in a field, damage occurs quickly as the leaf spots increase in size, killing the leaves.

cucumber mosaic virus (CMV) – CMV is most commonly transferred by aphids, but the virus can also overwinter in Maryland in a broad range of biennial and perennial host plants, including common garden weeds, and can be carried by aphids to new plantings.[25] The virus causes mosaic, distorted growth of plants, discoloration of leaves, and stunting of plants. Fruit from infected plants is small and usually distorted.[26] While CMV is common in the Northeast, if infection occurs late in the growing season, little yield loss results. Controlling Aphid population, constant weeding are the best preventative measures.

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