



for the Gardener

CENTER FOR AGROECOLOGY
& SUSTAINABLE FOOD SYSTEMS,
UC SANTA CRUZ

Peppers — From Sweet to Fiery

— Orin Martin

Orin Martin, manager of the Center's Alan Chadwick Garden, offers cultivation tips and a look at some of the many pepper varieties available for the home garden and field.

The pepper, genus *Capsicum*, is one of the more prominent of the 90 genera in the *Solanaceae* (Night Shade), a widely distributed family comprising 2000–3000 species with dominant centers in Central and South America. Along with several important food crops—the potato (*Solanum tuberosum*), tomato (*S. esculentum*), eggplant (*S. melongena*) and tomatillo (*Physalis ixocarpa*)—the *Solanaceae* includes many exquisite ornamental genera, such as *Salpiglossis*, *Brugmansia*, *Datura*, *Schizanthus*, *Nicandra*, *Petunia*, and *Nicotiana*.

Genus *Capsicum* (from the Greek *kapto*—to bite) is the nomenclatural home to all peppers, be they wild, cultivated, sweet or hot. There are approximately 20 species in the genus, but only 5 represented in domestication –

- *Capsicum frutescens* (= shrubby), 'Tabasco' peppers.
- *C. pubescens* (= hairy), including the South American 'Rocotos' and Mexican 'Manzanas'.
- *C. baccatum* (= berry like), the 'Ajis' of South America.
- *C. chinense* (= from China), the deadly hot 'Habañeros'. The specific name *chinense* is a misnomer, as the species originated in the Amazon Basin.
- *C. annuum* (= annual). Again, *annuum* is a misnomer, as all peppers are perennial shrubs in their native environment.

Capsicum annuum is the most widely grown of all pepper species, with commercial growing centers in the American Southwest, the Netherlands, British Columbia, Hungary, Portugal, Spain, Japan, Mexico, and the Caribbean. It is thought to have originated with the wild chiltepin or chilipiquin in Bolivia and southern Brazil before the arrival of humans in the Americas.

Both birds and people brought peppers north into Mexico and the Southwestern U.S. Birds were attracted to the small, upright, bright red fruit-of-origin pepper as a food source, and passed the seeds intact, distributing and planting them via guano. There is some dispute as to whether pre-Columbian indigenous peoples (via trade between the Toltecs of central Mexico and the Pueblos of New Mexico) or the Spanish colonialists were primarily responsible for assisting in the spread of peppers.

PEPPER CULTIVATION

CLIMATIC REQUIREMENTS

Because of their tropical origin, peppers cannot tolerate appreciable periods with temperatures below 50° F. They grow and fruit optimally with temperatures from 65°–85° F for sweet types, and 75°–90° F for chiles. Temperatures below 50°–55° F cause flowers to abort and/or misshapen fruit. Similarly, temperatures above 90°–95° F, will cause flower abortion. Sweet peppers are more sensitive to high heat than chiles. Texas A & M has developed varieties that withstand high heat; these are usually denoted with T.A.M. in the catalogues.

SEED & SEEDLING CARE

Pepper seeds are viable for one to two years, with viability falling off approximately 50% in the third year (viability refers to time to emergence and healthy, stocky seedling growth, as well as to the percent of seeds germinating). Both seeds and seedlings are prone to "damping off" fungus organisms, which flourish under cool soil/air temperatures, with poor air circulation and inadequate soil drainage.

Germination is optimal (10–14 days) at soil temperatures of 70°–85° F. At 60°–70° F, time to emergence is 21–28 days. At less than 60° F, percentage of

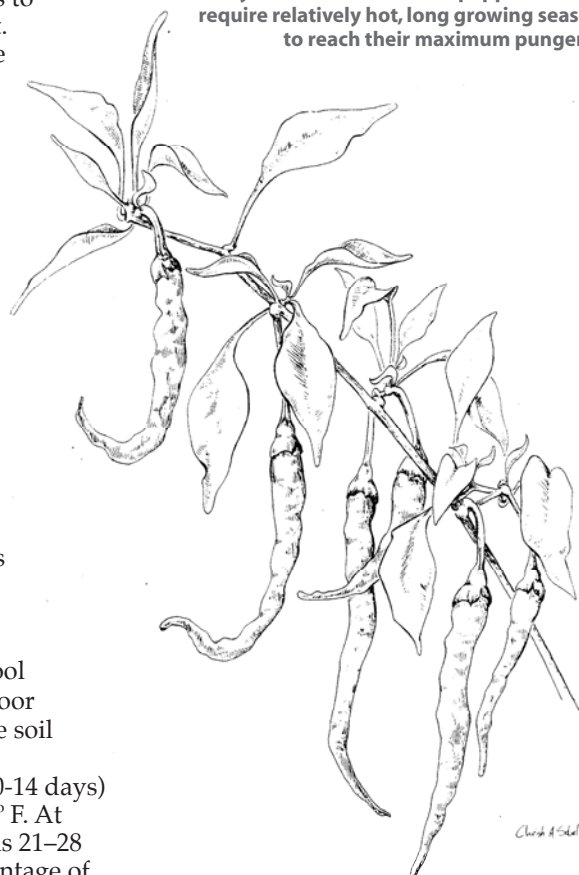
germination and resultant seedling growth will be inadequate.

Hardening off pepper seedlings is important. Slowly (over 10–21 days) weaning seedlings off the plush conditions of a greenhouse, and gradually acclimating them to "real world" garden conditions fosters a buildup of carbohydrate reserves that can be used to produce new feeding root tips to aid in minimizing transplant shock. Hardening off also thickens and toughens the cuticle layer of stem and leaf cells, making them more resistant to wind damage and transpiration losses.

TRANSPLANTING TIPS

Because pepper seedlings are very slow to develop, it's important to start seeds 10–12 weeks prior to your target transplanting date. Using varieties ap-

Cayennes and other chile pepper varieties require relatively hot, long growing seasons to reach their maximum pungency.



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appropriate to your area and setting out a large transplant when daily soil temperatures are 60° F at 4"–6" soil depth at mid day are keys to success in cool season and short growing season areas.

Peppers are adventitious rooters. If one to three leaves are pruned off and the plants transplanted deeply, roots will arise from the buried nodes, fostering better anchorage and greater root mass for foraging.

FERTILITY, IRRIGATION AND PLANT SUPPORT

Peppers (especially sweet varieties) need high nitrogen levels to establish the plant size and leaf canopy needed to protect fruit from sunburn. Some varieties have poor leaf canopy genetically, and either floating row covers or the age old technique of "dusting" the plants with a light layer of straw (often called strawing) can help. Phosphorus is important for flowering, sugar development and early root establishment. Potassium imparts cell strength, and thus is important to aid the plant in supporting its fruit load and developing good wall structure in fruits.

Because peppers are in the ground for a long period they respond well to incremental fertility inputs (in the form of foliar sprays such as compost tea, manure tea, or fish emulsion, or side-dressing with nitrogen sources). Peppers have extensive, fibrous, branching root systems that often extend wider (2–3 ft) than deep (1–2 ft) and forage efficiently for water and nutrients.

The main aim of growing peppers is to push the plant with nitrogen and water to establish a big vegetative plant that has many potential fruit sites, and to do it early in the season. However, early fruit set needs to be balanced with having "enough" plant before the fruiting cycle begins, or the result will be a few big peppers.

An ideal strategy (if space permits) is to have one bed at close spacing (9" between plants) for early cropping and one bed (12"–15" between plants) with early fruits thinned off to increase plant size for mid- to late-season cropping with overall higher yields. Each variety of pepper has a maximum fruit capacity, so picking peppers incrementally during the mid season allows subsequent waves of peppers to set and mature (in long season areas).

Withholding water from peppers during the growing season will negatively affect both yield and taste. Water

Pepper Classification System

<i>example</i>			
genus:	Capsicum	taste/texture:	mild when green, moderate
species:	annuum	hot/sweet: (scale)	pungency at maturation
pod shape:	New Mexican type	uses:	fresh green chile, whole dried, powdered as a spice
variety:	Española improved	comments:	truly early for a chile, significantly increased production, bred to tolerate cool, even cold nights
pod length:	7–9 inches		
pod width:	3–4 inches tapering		
immature color:	green		
mature color:	red		
seed source:	Native Seed Search		
maturation:	days to green – 70 from transplants		
	days to color – 90 from transplants		

management should promote a good oscillation between wet and dry, but soggy conditions in the root zone can kill the plant.

Because of the potential for a heavy fruit load (especially on hybrid bells), staking or netting will minimize stem breakage. One valuable product for support is Hortonova plastic trellis (6"x6" mesh) used in a horizontal trellis (available from Peaceful Valley Farm Supply, P.O. Box 2209, Grass Valley, CA 95945).

Harvesting should be done with clippers to leave a 1/4"–1/2" stem and to minimize physical damage to the plant. A stem serves as a physical buffer between the fruit and the environment which will retard the entry of fungi and bacteria, thus prolonging storage life.

PEPPER VARIETIES

Capsicum annuum comprises almost 2000 varieties which are the cultivated peppers of gardens and fields. It is interesting to note that there is no such thing as a sweet pepper in the wild; they are a product of human-directed plant breeding. This is especially true of sweet bell peppers, which have virtually exploded on the scene since World War II. At present there are well over 200 sweet bell varieties available to growers.

Paul Bosland, head of the New Mexico State University Chile Pepper Breeding program, has developed a helpful system for classifying the many varieties of peppers now available (see above).

Varieties of *Capsicum annuum* can generally be divided into sweet types and hot types (chiles). At one time all bell types were sweet and all chiles were hot, but this distinction has been blurred thanks to ingenious plant breeding. There are now pungent or hot bell varieties – Fajita Bell and Mexi-bell; and mild or sweet chile types – Señorita Jalepeño with all the jalepeño flavor but only a hint of the heat, or Delicias Jalepeño; and similarly, Sugar Chile, which is both sweet and mildly hot.

SWEET PEPPERS

With sweet peppers it is the development of sugar that is critical, not just the fact that they are non pungent. Unripe sweet peppers are just that – they have an "off," almost metallic taste that says immature fruit. The saying "Patience is a virtue" very much applies to peppers. By waiting an average of 3–4 weeks and allowing green fruit to "color up" you gain –

- a significant increase in the nutrition, particularly vitamins A and C.
- a taste treat, as the sugar content increases dramatically. This is even more pronounced towards the end of the growing season, when there is a radical swing between day- and night-time temperatures. The pepper, along with many vegetable crops (carrots, parsnips, peas, brassicas, and lettuces), increases its sugar content as a response to cold temperatures because sugar lowers the freezing point, enabling annual and

biennial crops to stave off the terminal effects of frost—a built-in life insurance policy.

- crispness and juiciness—two components of full flavor.
- looks—green is not a natural color of a mature pepper. In fact, there are no green mature peppers, but rather shades of red, orange, yellow, violet, brown, etc. A word of caution regarding violet/purple, white, and brown (chocolate) varieties. While they may be deemed attractive, they are problematic; they often have unacceptably small, irregularly shaped fruits. The seed catalogues use oblique, euphemistic phrasing referring to “very mild, light flavor,” but the smart shopper knows to read between the lines and interpret this to mean poor flavor and low sugar content. Conversely, some of the new hybrid yellow/orange bells are the sweetest tasting by virtue of their genetic makeup. However, these hybrids will cost appreciably more.
- price—if you are selling peppers, a typical retail price range in mid season would be: standard blocky green bells, \$.60/lb; distinctive varieties of color, \$1.50–\$2.00/lb.

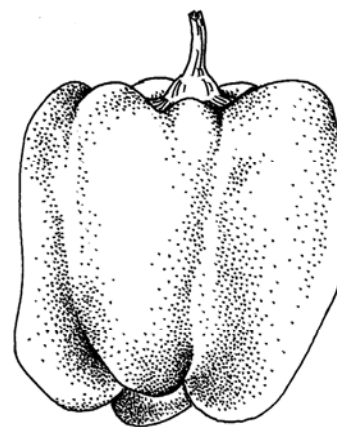
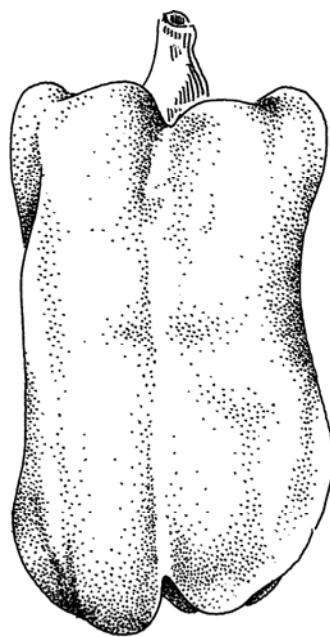
Sweet Pepper Varieties of Note

Bell Types

There are two basic bell pepper shapes—the classic U.S. blocky, 4-lobed type, and the elongated 3–4-lobed Lamuyo type. Note that some early varieties of bell peppers will never feature the uniform shape of either basic types (a definite drawback). Days to maturation listed below are from transplants and will vary depending on temperatures and latitude.

Red Bells

- *Cadice* – a notably early (55 days green, 70 days red) French hybrid that is blocky and elongated (often 6”–8” long). It is a good bet either in cool summer areas or short growing season areas, turning a glossy, crimson red at maturity with a juicy sweetness that is unparalleled.
- *Vidi* – another superlative red, French hybrid that can reach 9”–10” in length. Vidi features a high fruit load on a compact plant. It produces well in cool periods and tastes great.



The two basic bell pepper shapes: the 4-lobed U.S. type (above) and the 3–4 lobed Lamuyo type, typical of a European bell pepper.

Early Bells

Early bells tend to be smaller and not as perfectly shaped as later varieties. Also, at maturation the looks and especially the taste are generally inferior. Early bells also tend to overset fruit, contributing to the small, odd-shaped syndrome. However, they can be as much as 30–40 days earlier than the latest maturing varieties.

- *Ace* – 50 days green, 70 days red. Along with California Wonder, Ace is a standard extra-early, and a highly productive early variety.
- *Northstar* – 50 days green, 70 days red. Northstar is an early variety that produces medium to large, blocky, 3–4-lobed fruit.
- *Gypsy Bell* – 50 days yellow, 65 days orange/red. Although not a traditional bell shape, Gypsy is a hybrid that features a tall, productive plant (24”–30”) that produces 20–30 fruit in 2–3 waves. It is hands down the sweetest, best-producing early and cool season variety. The 3-lobed fruit is 5”–7” long and tapered. At the immature stage it is canary yellow and at full sweetness some fruit are orange while others are red. It is almost immune to sunburn – a top-notch winner.

Yellow/Gold/Orange Bells

These varieties tend to produce the sweetest, biggest, perfectly shaped

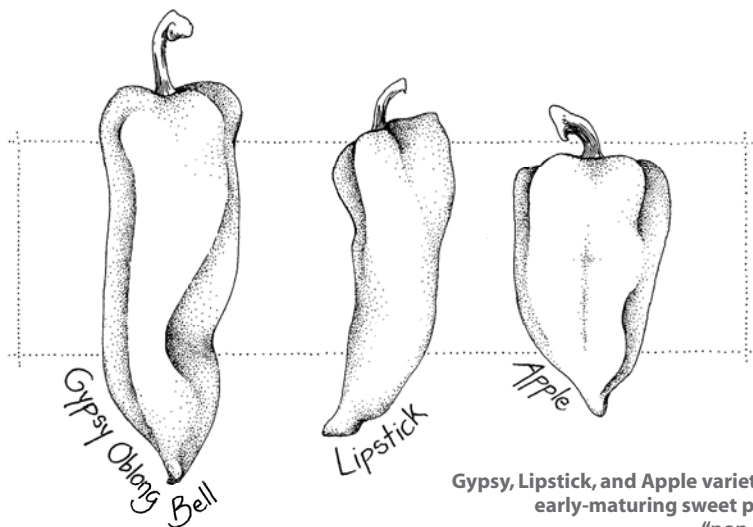
(blocky 4-lobed), latest-maturing fruit. Fruit load per plant is not always the highest and they tend to sunburn because of inadequate leaf canopy. They require the highest fertility inputs. Some varieties are also among the most expensive seed: Corona—250 seeds \$20.00, Yankee Bell—250 seeds \$7.00.

- *Corona* – 70 days green, 90–110 days orange. Corona produces stunning orange, medium to large, 4-lobed, blocky, candy sweet fruit on very compact plants.
- *Valencia* – 70 days green, 90–120 days orange. Valencia produces the biggest, blockiest, 4-lobed fruit of exceptional sweetness on mid-sized plants. Fruit-carrying capacity is moderate to low, the plants need exacting fertility and water inputs, and do not do well in cool season areas. This is the latest orange hybrid release.
- *Orobelle* – 70 days green, 90 days yellow/gold. A very productive, sweet, medium-large, thick-walled, 4-lobed bell that produces vibrant yellow/gold fruit of high quality, even in cooler growing areas.

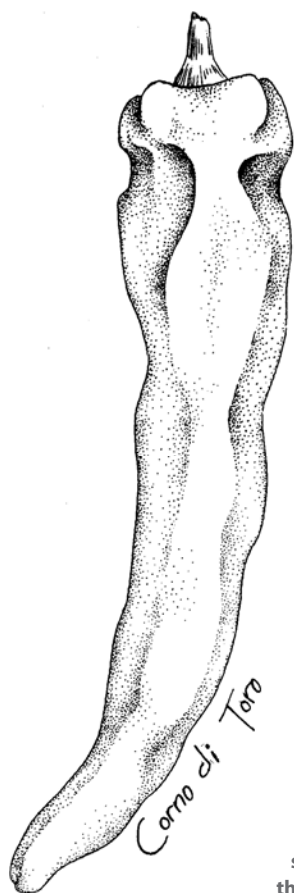
Non Bell Sweet Peppers

- *Lipstick* and *Apple* – 53 days green, 73 days red. These two varieties, while slightly different, are essentially “six of one/half a dozen of another.” They are sometimes the earliest maturing sweet

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Gypsy, Lipstick, and Apple varieties produce early-maturing sweet peppers with "non-bell" shapes



Corno di Toro bears heavy crops of long, sweet peppers that mature late in the season.

peppers in cool areas. They are small (3"–5"), tapered, top-shaped, and a rich shiny red. Relatively short (15"–18"), narrow plants can be spaced as close as 9"–10" apart without affecting production. No, the Apple variety doesn't really taste like an apple (thankfully).

- *Corno di Toro* (Italian Bull Horn) (Shepherd's Seeds) – 90 days green, 120+ days red/yellow. This is my personal favorite. *Corno di Toro* is a ridiculously late-maturing fall plant, sometimes reaching 4'–5' in height, that needs support because of its carrying capacity (12–20) of heavy, long, banana-/crescent-shaped fruit. While the catalogues describe the fruit as 6"–8" long, the yellow types often average 12"–18" long. Touted as a stuffing or frying pepper, I've found it rivals Corona and Valencia for sweetness. Unfortunately, most suppliers offer a mix of the red and yellow types. While the red is attractive, 6"–8" long and blunt nosed, the yellow fruit are bigger, elegant in shape, and more vigorous plants.

CHILE PEPPERS

Chiles feature multi-stemmed, almost shrub-like plants which require considerably less nutrient and water inputs than sweet peppers. They carry a higher number (some in excess of 100) of smaller fruits per plant than sweet peppers and reach their true high heat and full flavor in hot, long-season growing regions. Because they are thin walled with a low water content they dry well.

Capsaicin, which is responsible for the chile pepper's burning pungency, is a complex of compounds that creates a very stable alkaloid to which human taste buds are sensitive in as little as one part per million. It has no flavor, odor, or color.

Pepper hotness has been categorized by the Scoville Heat Unit System, and ranges from 0 on some sweet peppers to 4,000 units for jalapeño, 70,000 units for tabasco, and 557,000 units for the hottest of the habaneros. Generally, the smaller the fruit, the greater the pungency. Capsaicin irritates pain receptors in the nose, stomach and mouth. Repeated use (in one sitting and over time) produces endorphins that mask the pain and induce a mild euphoria. Milk and foods high in starch, such as bread and tortillas, are a good short-term antidote.

There are two evolutionary reasons for capsaicin's presence in peppers –

- It promotes germination by acting as an anti-fungal agent to retard fungal organisms from attacking seeds.
- It protects the ripe seed pods from unwanted predators (mammals sensitive to capsaicin) so that preferred predators (birds, which are immune to the burning sensation) can distribute seed. Small wild peppers are commonly called bird peppers.

Capsaicin is produced by glands in the union between the fruit's pod wall and the placenta, and tends to spread unevenly throughout the fruit, usually being absorbed into seeds, and to a lesser extent the flesh. Often the tip of a chile will lure you on with little or no pungency, while the stem end elicits a five-alarm fire response.

Capsaicin begins forming within two to three weeks of fruit development and increases until maturation. Dried chiles are approximately ten times as hot as mature, fresh chiles.

Chile Varieties of Note

Mild Chiles (New Mexico pod types)

- *Paprika Supreme* – 80 days green, 100–120 days red ripe. A recent hybrid introduction of the Hungarian sweet paprika types. *Paprika Supreme* features tall, productive plants carrying 10–20 wide, flat, 8"–10" long, light red fruits that taper to a point, and like most chiles, are virtually immune to sunburn. They are sweet off the plant, can be dried for

ristras (pepper strings) and powdered for a sweet paprika. *Kolasca Sweet* is a nearly identical variety.

- *Jimmy Nardello* – 65 days green, 85 days dull red ripe. A unique heirloom variety. The peppers are 8"–10" long and tapered (like a cayenne on steroids). They have a dull sheen and a wrinkled skin. Although people mistake it for a chile, this variety has a "smoky" sweet flavor and is a tall, bushy plant that bears 30–40 fruits which are good for drying as well as fresh eating.

- *Española* (improved) – 70 days green, 90 days red. Undoubtedly the best of the classic New Mexico pod shapes for cool season areas. Bushy, branched plants set 20–30, 3" wide, flat, 6"–8" long, sinuous-shaped chiles that often are tinged with black at the red ripe stage. They are moderately pungent – more so at the stem end.

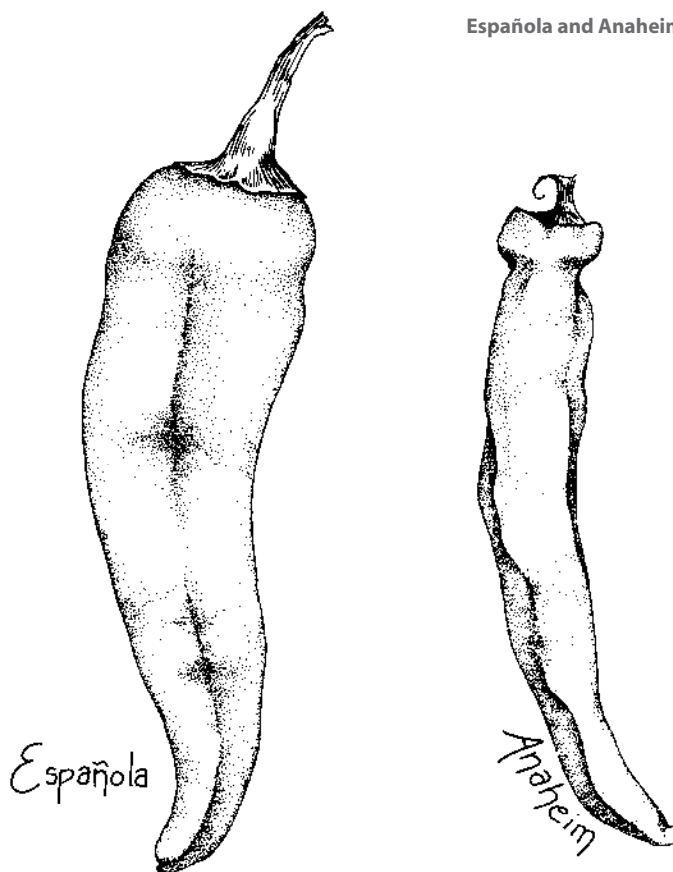
- *Anaheim*, *New Mexico Joe E. Parker*, *Sandia*, *New Mexico Big Jim*, *Chimayo*. These are all similar to *Española*, but require more heat and time to fully mature. Big Jim is sometimes heralded as the longest (10"–12") New Mexico fruit type.

- *Ancho/ Poblano* – 65 days green, 90–110 days reddish/ brown. At the green stage this variety is called Poblano; when mature and dried it's called Ancho (meaning wide). Multi-stemmed, compact, 2'-high plants, carry 5"–6"-long and 3"-wide pendant, conical, truncated pods with indented shoulders. Immature pods are a dark, glossy green, turning a dark, reddish brown at maturity. They are fruity and mildly pungent when dried. Produces best in hot climates. Anchos/ Poblanos are used for rellenos and molé sauces. *Mulato Isleno* is a similar variety that dries to a chocolate brown instead of red and has a smokier flavor.

Small-Fruited Hot Chiles

- *Paper Dragon* – 55 days green, 80–90 days red. The earliest maturing cayenne-shaped chile for drying and fashioning into ristras, or grinding into fine chile powder (dry and then use a coffee grinder). Paper Dragon features 7"–8" long, slim, tapered, thin-fleshed, metallic-red fruits. An abundant producer of medium-hot peppers.

- *Thai Dragon*, *Big Thai*, *Hot Thai* – 60 days green, 90 days red. Approximately



Española and Anaheim are popular varieties of the relatively mild, New Mexico-type chiles

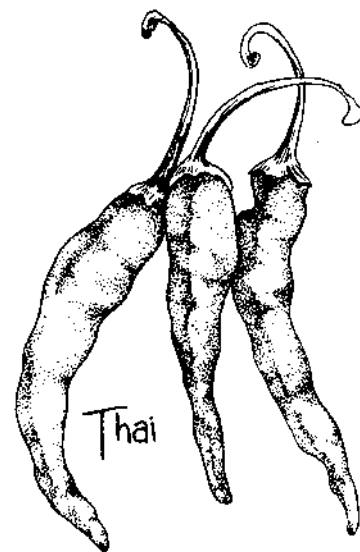
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5 times hotter than jalapeños, these varieties are all similar-looking, small (2"–3"), conical, very hot peppers featured in Southeast Asian cuisine. They prefer growing areas with high heat (night as well as day) and high relative humidity. Small bushy plants carry many fruit.

- *De Arbol* – 90–100 days green, 120 days red. Snub-nosed cayenne look alike. Somewhat hotter than cayenne. Plant is rangy ("tree like"), grows to 3' high, and many branched with dozens of fruit.

- *Salsa Delight* – 70 days green, 90–110 days red ripe. A long (7"–9"), slim (1/2"), cayenne-shaped variety from Turkey. One of the mildest hot chiles with that distinctive fruity aroma. Similar in appearance, but not as hot as chile Aci Sivri from Turkey (which can be flaming hot). Can carry 50–60 fruits per plant.

The Thai varieties produce an abundant crop of small, fiery-hot chiles.



- *Fire Cracker* – 90–100 days purple, 120–140 days orange/red. Attractive, large-branched shrub (3'x4'), bearing many hundreds of 1"-long, purple, conical fruit, often held upright. Very hot. Plants continue growing into rain and cold. Purple flowers.

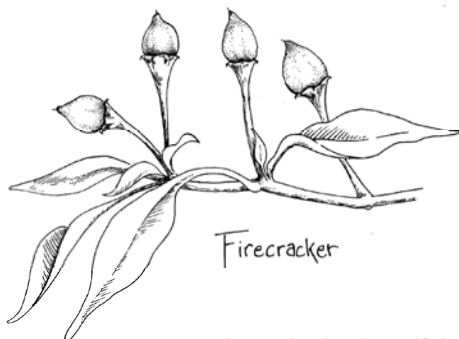
- *Serrano/Super Serrano* – 65–75 days green, 85–95 days red. Small (2–3" long), finger-shaped fruits can be used green or red, fresh or dried. Extremely hot. Can store for extended periods fresh. Commonly pickled. Super Serrano is somewhat earlier.

- *Giant Jalapeño, Early Jalapeño, Delicias, Señorita* – 85–90 days green, 110–130 days red. Blunt, 3" x 1", dark-green fruits are borne prolifically on medium-sized plants. Used fresh or pickled—extremely hot. *Delicias* and *Señorita* are milder versions of the standard jalapeño. When smoke dried they are called chipotles.

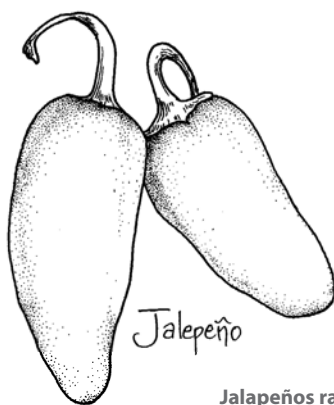
- *Habanero (Capsicum chinense)* – 75 days green, 120 days orange. Also known as "Scotch bonnet," these orange/golden, small (2"–3"), lantern-shaped fruits are approximately 1,000 times hotter than jalapeños. Small, spreading plants need heat and a long growing season to ripen to full intensity. Warning: this pepper can literally burn your tongue and taste buds. Two or three fruits in five gallons of chile can be unbearably hot.

- *Caribbean Red Habanero* – A recent Habanero that is up to double the heat of the standard Habanero.

– Orin Martin



Firecracker is a beautiful ornamental plant producing pungent purple fruits that mature to a deep red.



Jalapeños range from fiery to mildly hot and can be used fresh, pickled, or smoked as chipotles.

Resources

Book of Garden Secrets, by D. Patent and D. Bilderback. Camden House Publishing Co., 1991.

Peppers of the World, by D. Dewitt and P. Bosland. Ten Speed Press, 1996.

The Great Chile Book, by M. Miller. Ten Speed Press, 1991.

The Pepper Garden, by D. Dewitt and P. Bosland. Ten Speed Press, 1993.

World Vegetable Crops, by M. Yamaguchi. Van Nostrand Reinhold, 1983.

Seed Companies of Note

* - Have good pepper varieties

- Have open pollinated/heirloom peppers

* Bountiful Gardens
18001 Shaffer Ranch Rd.
Willits, CA 95490
707/459-6410
www.bountifulgardens.org

* W. Atlee Burpee & Co.
300 Park Ave.
Warminster, PA 18974
800/888-1447
www.burpee.com

* J.L. Hudson, Seedsman
PO Box 337
La Honda, CA 94020
www.jlhudsonseeds.net

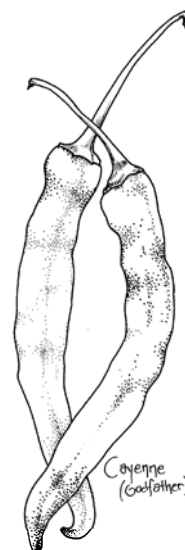
* Johnny's Selected Seeds
Foss Hill Rd.
Albion, Maine 04910
207/437-4301
www.johnnyseeds.com

* Nichol's Garden Nursery
1190 Old Salem Rd., NE
Albany, OR 97321
503/928-9280
www.nicholsgardennursery.com

#* Redwood City Seed Co.
P.O. Box 361
Redwood City, CA 94064
650/325-7333
www.ecoseeds.com

#* Renee's Garden
7389 W. Zayante Rd.
Felton, CA 95018
888/880-7228
www.reneesgarden.com

* Seed Savers Exchange
3094 North Winn Rd.
Decorah, IA 52101
www.seedsavers.org



Cayennes can be dried for ristras and chile powder or used to make spicy vinegar.

#* Seeds Blum
HC33 Idaho City Stage
Boise, ID 83716
800/528-3658

* Seeds of Change
P.O. Box 15700
Santa Fe, NM 87506
www.seedsofchange.com

* Stokes Seed Company
P.O. Box 548
Buffalo, NY 14240
800/396-9238
www.stokeseeds.com

* Territorial Seeds
P.O. Box 158
Cottage Grove, Or 97424
800/626-0866
www.territorial-seed.com

* The Cook's Garden
P.O. Box C5030
Warminster, PA 18974
800/457-9703
www.cooksgarden.com

* Totally Tomatoes
www.totallytomato.com