

## Hot Pepper (*Capsicum spp.*) – Important Crop on Guam

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Source: <https://phys.org/news/2009-06-domestication-capsicum-annuum-chile-pepper.html>

### Introduction

Hot pepper, also known as chili, chilli, or chile pepper, is a widely cultivated vegetable crop that originates from Central and South America. Hot peppers belong to the genus *Capsicum*. There are over 20 species under the genus *Capsicum*. There are five major domesticated species of peppers that are commercially cultivated (Table 1), and there are more than 50,000 varieties. Fig. 1 depicts a unique, citrus-flavored variety of *Capsicum baccatum* hot pepper, known as Lemon Drop (aji-type), popular for seasoning in Peru (Wikipedia, 2017).

**Table 1. The five major domesticated *Capsicum* species of pepper with examples of commonly known types of pepper.**

Species	Types
<i>Capsicum annuum</i>	bell pepper, wax, cayenne, jalapeno, bird
<i>Capsicum frutescens</i>	tabasco, Thai, malagueta
<i>Capsicum baccatum</i>	aji
<i>Capsicum chinense</i>	Scotch bonnet, habanero, ghost, scorpion
<i>Capsicum pubescens</i>	rocoto

Most *Capsicum* peppers are known for their spicy heat. Some varieties have little to no spice such as paprika, banana peppers, and bell peppers. The spice heat of *Capsicum* peppers are measured and reported as Scoville Heat Units (SHU). In 1912, American pharmacist, Wilbur Scoville, developed a test known as the, Scoville Organoleptic Test, which was used to measure pungency (spice heat) of *Capsicum* peppers. Since the 1980s, pungency has been more accurately measured by high-performance liquid chromatography (HPLC). HPLC tests result in American Spice Trade Association (ASTA) pungency units. ASTA pungency units can be converted to SHU. Table 2 displays Scoville Heat Units of various popular *Capsicum* peppers (Wikipedia, 2017).



Fig. 1. *Capsicum baccatum* – Aji pepper, variety: Lemon drop. Source: [https://en.wikipedia.org/wiki/Lemon\\_drop\\_pepper](https://en.wikipedia.org/wiki/Lemon_drop_pepper)

**Table 2. Scoville Heat Units of various popular Capsicum peppers.**

Scoville heat units	Name of peppers
855,000 – 2,480,000	Carolina Reaper, Komodo Dragon Chili, Bhut Jolokia (Ghost Pepper), Trinidad Scorpion Butch T, Bedfordshire Super Naga, Spanish Naga Chili, Dragon's Breath
350,000 – 580,000	Red Savina Habanero
100,000 – 350,000	Habanero Chili, Scotch Bonnet, Datiler, Rocoto, Madame Jeanette, Peruvian White Habanero, Jamaican, Fatalii Wiri Wiri, Bird's Eye Chili
50,000 – 100,000	Malagueta pepper, Chiltepin pepper, Piri piri, Pequin Pepper, Siling Labuyo, Capsicum Apache
30,000 – 50,000	Guntur Chilli, Cayenne Pepper, Ají Pepper, Tabasco Pepper, Capsicum chinense
10,000 – 30,000	Byadgi chilli, Serrano pepper, Peter Pepper, Chile de árbol, Aleppo Pepper, Cheongyang Chili Pepper, Peperoncino
3,500 – 10,000	Guajillo Pepper, Fresno Chili, Jalapeno, Wax (e.g. Hungarian Wax Pepper)
1,000 – 3,500	Anaheim Pepper, Pasilla pepper, Peppadew, Poblano (Ancho), Poblano verde, Rocotillo Pepper, Espelette Pepper
100 – 1,000	Banana Pepper, Cubanelle, Paprika, Pimento
0	Bell Pepper

Source: [https://en.wikipedia.org/wiki/Scoville\\_scale](https://en.wikipedia.org/wiki/Scoville_scale)

Hot peppers are very popular throughout the world. In markets, they are sold as a fresh vegetable, dried/roasted, pickled, and as additives in many products. In Guam stores, fresh local hot peppers average \$12.00/lb, and local bi-products of hot peppers like “Fina’denne’ dinanche” averages \$1.00/oz (Bamba, personal communication).

Hot peppers are commonly used as a spice for a wide variety products and dishes throughout the world. Locally, they are used for local hot sauces and many local spicy dishes.

There are numerous health benefits of hot pepper. Hot peppers are a good source of Vitamin A, and Vitamin C, particularly the mature fruits (University of Illinois Extension, 2017). Fig. 2 shows basic nutrition facts of 1 serving of raw, red hot/chili pepper as provided by the United States Department of Agriculture (USDA).



Fig. 2. Nutrition facts of raw, 1 serving size of raw red hot/ chili pepper. Source: USDA.

**Growing Hot Pepper**

Hot peppers can be transplanted as a seedling or direct-seeded in to the ground (University of Missouri Extension, 2017). Seeds usually germinate within 2 weeks in the nursery or ground. Commercially, peppers are commonly spaced 1-3 ft. between plants (single or double rows) and 4-6 ft. rows.

Hot peppers grow best in day temperatures of 75-85°F (24-30°C) and night temperatures of 50-60°F (10-15°C) (Smith *et al*, 2008), but can tolerate Guam’s hotter temperatures, and can be cultivated all year round on Guam. In tropical regions, peppers grow as perennial plants (can grow for more than one season) plants, but because plants are tender and are easily killed by frost, peppers are most often cultivated as an annual (one growing season) in temperate regions (University of Missouri Extension, 2017).

A general fertilizer recommendation for one growing season for hot pepper is 870 lbs. of 10:10:10 (N-P2O5-K2O) per acre, or approximately 2.0 lbs. of the same nutrient ratio for every 100 sq. ft. (Florkowska and Westerfield, 2011).

Hot pepper plants grow best in moderately fertile, well-drained soils (Iowa State University Extension, 2009) such as Akina silty clay, Guam-Saipan complex, Guam-Yigo complex, Pulantat clay, and Togcha soils. Guam cobbly clay loam is a shallow limestone soil that is not very fertile, but with proper management, hot pepper can be productive in this soil. The plants are not particularly sensitive to soil pH, but best results are obtained when soil is in the 6.0-6.8 range (Iowa State University Extension, 2009).

Watering regularly will keep your plants producing fruits. Pepper plants prefer moist, but not wet soils. Irrigation of hot pepper should consist of light, frequent watering. During dry periods, ensure soils are kept moist and not saturated. During extended rainfall events, watering may not be necessary until soils are nearly dried up. Mulching around pepper plants will conserve moisture.

### Common Pests and Diseases

Hot pepper is a host for a wide range of pests and diseases. Many of these pests and diseases are found on Guam. They include aphids (Family: Aphididae), whiteflies (*Bemisia spp.*), fire ants (*Solenopsis geminata*), leafhoppers (*Liriomyza spp.*), green semi-looper (*Chrysodeisix eriosoma*), and the cluster caterpillar (*Spodoptera litura*). Registered insecticides can help control insect infestations. Insect pests can also be controlled by cultural practices such as monitoring, crop rotation, weeding, and general field sanitations. (Semini, 2006), (Guam Cooperative Extension, 2016).

Some common diseases include Bacterial Spot (*Xanthomonas campestris*) (bacteria), Cercospora Leaf Spot (*Cercospora spp.*) (fungus), Damping Off (*Pythium spp.*) (fungus), Anthracnose Fruit Rot (*Colletotrichum spp.*) (fungus), Southern Blight (*Sclerotium rolfsii*) (fungus), Cucumber Mosaic (*Cucumber mosaic virus*) (virus), Tobamoviruses, and Tobacco mosaic virus (virus). Some fungal and bacterial disease can be

controlled with registered fungicides and bactericides. Viral diseases may not be controlled, but controlling the insect vector will reduce spread of the virus. Some prevention measures to reduce chances of diseases and avoid pesticide use include growing hot pepper in full sunlight, avoid long periods of soil saturation, keep farm tools clean, and choose disease resistant varieties if possible (Semini, 2006), (Guam Cooperative Extension, 2016).

### Plant Care

It is always good practice to consistently monitor plants for pests and diseases. If a pest or disease is unknown, collect samples if possible and submit to CNAS Extension & Outreach program for correct identification and treatment recommendations.

Weeding and mulching around plants will reduce weed competition and conserve soil moisture. It is also advisable to keep good records of all field activities. Good record-keeping will identify good practices and mistakes, along with identifying desired varieties of plants. This will improve decision-making for future crops.

### Harvest

Hot peppers can be harvested at any stage of fruit growth desired. Most varieties mature approximately 60-110 days after planting. Fruits are usually harvested when mature, but can be harvested at any stage of growth. Hot peppers, depending on variety, display maturity when fruits turn to colors such as yellow, orange, red, and other uncommon colors like purple. With proper management and care, plants can produce quality harvest for more than one growing season.

### Post-Harvest Handling

Immediately after harvest, hot peppers should be cooled and stored at 45-50°F (7-10°C) at 95% relative humidity to slow down water loss and decay. Hot peppers stored at temperatures colder than 45° (7°C) will result in chilling injury to the hot peppers. Extended periods of storage at temperatures greater than 50° (10°C) will cause peppers to change color, lose fresh weight and decay (University of Missouri Extension, 2010).



**2017 Hot Pepper (*Capsicum annuum*) Trial on Guam**

There are numerous seed sources of hot pepper varieties of several *Capsicum* species available on the internet from seed companies like Baker Creek Heirloom Seed Co. (<http://www.rareseeds.com/>), Kitazawa Seed Co. (<http://www.kitazawaseed.com/>), Johnny’s Selected Seeds (<http://www.johnnyseeds.com/>), and Burpee (<http://www.burpee.com/>). Known-You Seed Company, a well-known seed company, provides several varieties of hot pepper seeds through a local vendor, Guam Home Center. There are also many varieties that are grown by local producers on Guam.

A variety trial was conducted at the Western Pacific Tropic Research Center, Yigo Agricultural Experiment Station, College of Natural & Applied Sciences, University of Guam. On December 6, 2016, five varieties of hot pepper, *Capsicum annuum*, were transplanted in Guam Cobbly Clay Loam soil, a commonly cultivated soil in northern Guam, after growing in plant trays for 24 days. Growth characteristics were observed and marketable yield data was collected. Harvesting occurred from February 10 through April 28, 2017. Mature fruits were harvested and weighed, and classified as marketable or non-marketable. The five varieties grown for the variety trial are shown in Figs 3, 4, 5, 6, and 7. Table 3 displays average sizes and weights of individual fruits of each variety from this trial.

**Table 3. Average sizes and weights of individual fruits.**

Cultivar/ Variety	Average Length (cm)	Average Width (mm)	Average Weight (g)
Ascent	3.80	9.52	1.78
Guafi	5.71	9.91	2.90
Hachon	4.98	8.26	5.03
Red Air	4.21	9.62	2.19
Thai Yellow	7.32	18.27	10.31



Fig. 3. Hachon: Local, non-hybrid variety.



Fig. 4. Guafi: Local, non-hybrid variety.



Fig. 5. Ascent F1: Hybrid variety.



Fig. 6. Red Air F1: Hybrid variety.



Fig. 7. Thai Yellow: non-hybrid, heirloom variety.

Prior to harvest, the entire field became infected with Anthracnose fruit rot, as symptoms were displayed on leaves and immature fruits, but was controlled with weekly applications of Neem oil. The Neem oil treatment proved to control the fungus, which resulted in more ‘marketable’ versus ‘non-marketable’ fruits as shown in Fig. 8. Neem oil was also used to control occasional occurrences of aphids, white flies, and mealybugs.

**Total % Marketability of Harvested Fruits**

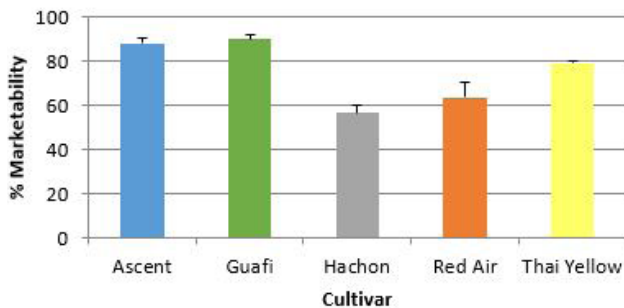


Fig. 8. Percent marketability of mature fruits (harvested Feb. 10 - Apr 28, 2017).

The local variety ‘Hachon’ was infected early during initial flowering and fruiting by an unidentified disease that left all Hachon plants stunted resulting in significantly low flower and fruit production. Hachon resulted in less than 60% marketable fruits (Fig. 8). As fruits from all varieties were consistently maturing by early April, Ascent and Red Air and Guafi produced a high number of mature fruits in comparison to Thai Yellow and Hachon. Total number of harvested fruits of Thai Yellow was clearly lower than Ascent, Red Air, and Guafi, but because of the larger-sized peppers of Thai Yellow, this variety resulted in the highest yield in total weight (lbs. per acre) (Figs 9, 10, and 11).

**Total Fruits Harvested**

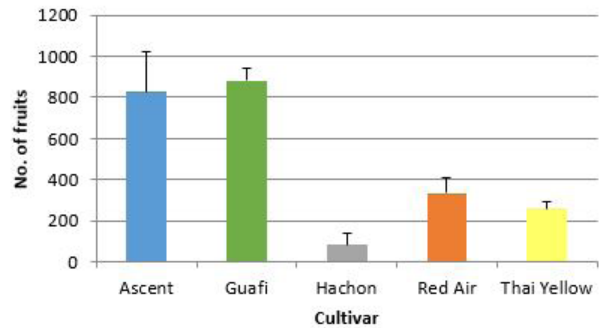


Fig. 9. Total number of mature fruits (harvested Feb. 10 - Apr. 28, 2017).

**Average Number of Harvested Fruit per Plant**

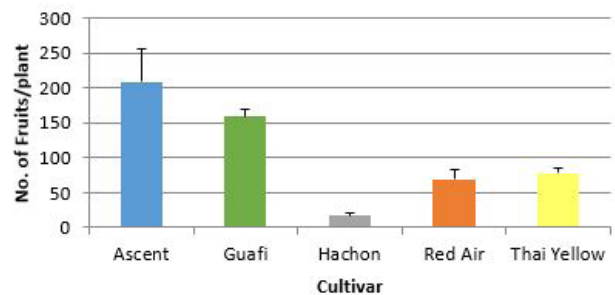


Fig. 10. Average number of mature fruits per plant (harvested Feb. 10 - Apr. 28, 2017).

**Total Yield (lbs/acre)**

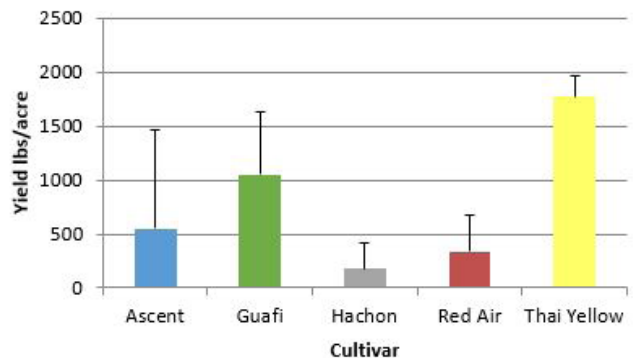


Fig. 11. Total Yield (harvested Feb. 10 - Apr. 28, 2017).

Both F1 hybrids, Ascent and Red Air, produced early harvests in comparison to all non-hybrid varieties. Ascent and Red Air produced mature fruits approximately 3 weeks before non-hybrid varieties produced mature fruits. Many hybrid varieties are bred to provide earlier harvest as displayed in this trial experiment. Peak harvest for Red Air, Ascent, Guafi, lasted significantly longer than Thai Yellow (Fig. 12).

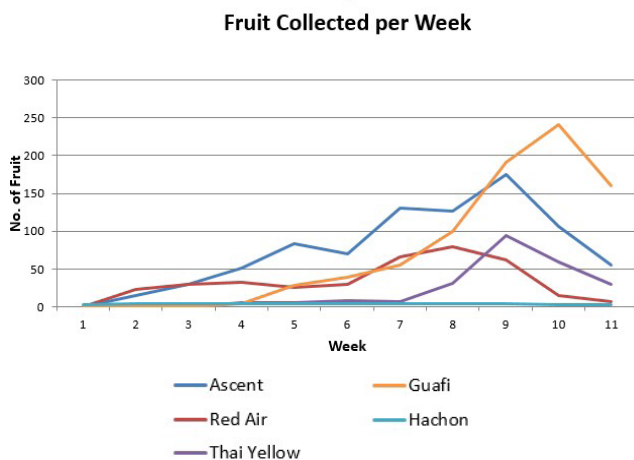


Fig. 12. Timeline displaying weekly harvest (harvested Feb. 10 - Apr 28, 2017).

## Discussion

Hot pepper is a nutritious vegetable that is served in many restaurants, local gatherings, and home-prepared meals on Guam. It can be grown in Guam's climatic conditions, and it is fairly easy to cultivate. It can be grown commercially or as a home garden plant. Hot pepper is a high-value commercial crop for Guam growers. There are many varieties available locally and by commercial seed companies from Far East Asia, United States, and other countries where hot pepper is an important crop. When choosing a variety, it is advisable to choose those that have resistance to certain diseases. Because peppers are native to tropical America, most varieties should be appropriate for growing in Guam's tropical climate.

## For Support

Contact the College of Natural & Applied Sciences' Extension and Outreach at 735-2080 for help or more information. Additional publications can be found on our website at: [www.cnas-re.uog.edu](http://www.cnas-re.uog.edu) under the Publications tab.

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