

# HASS CULTIVATION IN MEXICO

Reuben Hofshi, Chair,  
Production Research  
Committee CAC

Mexico is the world's largest producer of Hass avocados. It produces over 65% of the world's Hass avocados with an average yearly production exceeding 1.5 billion lbs. It is the dominant player in many global markets when its avocados are in season. Mexico has an increasing presence in the U.S. market with further expansion being contemplated by the U.S. government. Most of the Mexican Hass avocados are grown in the state of Michoacan in west-central Mexico. Although other states in Mexico grow the Hass variety, the oldest groves, dating back to 1961, are located near the city of Uruapan. Michoacan is the only state in Mexico permitted to export Hass avocado into the U.S.

Michoacan accounts for 82% of the total acreage planted to avocados in Mexico and for 84% of its production. Currently there are close to 190,000 acres of avocados in Michoacan with 95% or 180,500 acres planted to Hass. Hass avocados are grown at elevations ranging from 4,300 to 7,400 ft.

above sea level. There are four distinct climatic zones: (1) from 4,300 to 5,500 ft.,

(2) from 5,500 to 5,800 ft., (3) from 5,800 to 6,500 ft., and (4) from 6,500 to 7,400 ft. Thirty percent of the Hass planting is in zone one, 40% is in zone two and three, and the remaining 30% is in zone four. Different temperatures, humidity, average fruit production and of course different maturity periods distinguish these zones. The occurrences of a variety of pests and diseases are also delineated by these zones. Average production in well-maintained groves is the highest in zone one, at 26,700 lbs. per acre and the lowest at 13,000 to 16,000 lbs. per acre in zone four.

There are several soil types in the production zones. These soils are classified as Andosols, which are mostly volcanic in origin, ranging from volcanic ash to coarser volcanic soil. Some areas have heavier soils that contain varying levels of clay. It is in these soils where limited manifestation of root rot (*Phytophthora cinnamomi*) is found. The soils are rich in organic matter ranging from 4 to 10% originating from the pine forests, the common native vegetation of these lands. Soil pH ranges from 5.5 to 6.5 and occasionally as high as 7.0. The soils are rich in iron, aluminum and potassium, but are short of zinc, boron, calcium, and available phosphorus.

The climate is temperate with a warm rainy summer that lasts from June through September, and a more moderate to semi-cold period the rest of the year. Occasionally a freeze occurs, especially in the higher elevations. The temperatures are rather constant, with some variations during winter, where the night minimum can be as low as 45°F and the maximum daily temperatures around 64°F. Maximum daily highs seldom exceed 82°F. The common

relative humidity ranges between 75-80% year round, with occasional dipping to as low as 60%. Rainfall is between 40-70 inches per year. There are over 1,000 light hours per year available for photosynthesis.

Over 80% of all groves have some type of supplemental irrigation during the dry months, while the rest of the groves depend solely on rainwater during the wet season. In some cases, there is no water available for irrigation. It is the moisture holding capacity of the deep volcanic soils, coupled with the high air humidity and mild temperatures that keep the non-irrigated groves viable. The trees, under most circumstances, show no sign of tip burn on their leaves. Where water is available, it is of very high quality containing insignificant amounts of salts. In some areas, water is actually trucked to groves and basins around individual trees are filled with water. Where unpressurized canal water is available, secondary canals fill basins around trees, or the groves are flood irrigated. Where pressurized water is available, portable rainbirds, drip irrigation and micro-sprinklers are common. Growers tend to irrigate once a month in the cool, early part of the year, applying approximately two inches per irrigation period. The irrigation frequency is increased as the weather warms until the beginning of the rainy season in June. Tensiometers, when used, are placed at 12 and 24 inches and water is applied when a 20 centibar threshold is reached on the 12-inch probe and even at a lower reading at 24 inches.

Fertilizers are applied manually during the rainy season in the non-irrigated or flood-irrigated groves. Sprinkler-irrigated groves are often fertigated at different intervals throughout the year. One common practice, which used to be the only means of fertilizing in the past, is to apply manure either yearly or bi-annually. All types of manure are used, applied just prior to the rainy season to minimize salt damage, in a



wide band along the drip line. The quantity applied is equivalent to 110 lbs. per year. Some growers apply compost made of 30% manure, 30% straw or spent sugar cane, 30% topsoil, a small amount of calcium carbonate (lime) and ordinary or triple super-phosphate. Phosphate in the soils rapidly becomes unavailable by forming insoluble compounds such as iron, aluminum and calcium phosphates. The addition of large amounts of phosphates, (4.4 lbs./year), not as part of a compost mix, is likely to create problems for the growers in the long run. Nitrogen, in the form of ammonium nitrate or urea, is applied at the rate of 4.4 lbs. of actual N per tree per year. Potassium (2.2 lbs. per tree per year) is applied mainly as potassium chloride, which is inexpensive and highly soluble. About 1 lb. of granular zinc sulfate is also applied per tree once a year. In general however, trees do not appear to be excessively lush; leaves are smaller than in California, paler and with a more reduced leaf density.

Most commercial groves are monocultures of the Hass variety grafted on Mexican seedling rootstocks. Only occasionally does one encounter a native Mexican (criollo) variety or Fuerte trees in well-maintained commercial groves. In the suburban areas, where small groves are located, there is a higher incidence of native or other known varieties such as Nabal and Fuerte.

Farmers generally do not introduce honey bees to the groves for pollination purposes. In previous years hive placement in groves was more common, but with the Africanization of bee colonies, the honey bees became more aggressive to the point where farm workers were being stung repeatedly forcing the removal of the colonies. Currently, hives are being restocked by imported milder queens allowing the reintroduction of honey bee colonies in the avocado groves. The opinion of most is that the avocado flowers are pollinated by an assortment of wasps and other insects that visit the groves during bloom. Having little competition from wild flowers and other blooming trees, the avocado trees appear to be well visited and pollinated. Dr. Gad Ish-Am has been searching in Mexico and Guatemala for the natural pollinator of the avocado. He and his associates have identified

several local species of stingless bees (*Apidae, Meliponinae*) and the Mexican Honey Wasp (*Brachygastra mellifica*) that were extensively visiting the avocado flowers. Studies conducted in Michoacan by Lucy Quiñones to investigate if Hass would set fruit in the absence of a pollinator vector indicated that there was no fruit set when the trees were caged and insects were excluded.

There are five distinct blooms and fruit set periods in most growing zones. In the lower elevations there is a more pronounced early fruit set. The first bloom, or off-bloom ("crazy flower" or "flor loca" in Spanish), occurs in September. The off-bloom fruit in the warmer zones are indistinguishable from regular fruit but are distinctly larger than the rest of the following fruit set. Only in the cooler areas is the off-bloom fruit round and smooth-skinned like California Hass off-bloom. The second bloom, which occurs in October, produces the "chancy" bloom ("venturera" in Spanish). Early bloom ("avancada" in Spanish) occurs in November. The regular bloom, which produces the majority of the fruit set, occurs in January and February and could be subject to freeze in the upper elevations. The late bloom, particularly in the upper elevations, occurs in March ("Marceña" in Spanish). In elevations lower than 5,500 ft. off-bloom fruit could reach maturity in June; in the cooler zones during August. (Dry matter standards are the same as in California.) Lower elevation groves are picked by the end of May, while the highest groves can pick their late bloom fruit as late as August. Some of the mature fruit from all zones are very similar in appearance to fruit from Santa Barbara County where mild webbing on the avocado peel is noticeable. The webbing and deformities are caused by thrips. The majority of the Hass avocados are indistinguishable in appearance from Hass fruit harvested anywhere in the world and with fine flavor. The notion that Mexico is 'out' of Hass avocados in certain months of the year is erroneous. In Michoacan there are normally plenty of Hass avocados 365 days of the year. As in any other growing area, Mexico has a peak production period that lasts from August through April, with a significant decline in May through July.

A variety of pests and diseases are encountered in Michoacan. Brown mite is a problem that appears to be more pronounced in dusty areas. Good predator activity keeps things in balance, but pesticides applications are recommended for more severely infested groves. The pests that can significantly affect productivity are a variety of thrips (*Frankliniella*, *Scirtothrips aceri*, *Liothrips perseae* and *Scirtothrips perseae*). The thrips attack young leaves, flowers and young fruit and can cause drop and malformation and severe scarring of the fruit. Certain weeds are hosts for the thrips when conditions on the avocado trees are not favorable. During bloom, vegetative growth and fruit formation, one of several insecticides is recommended. Application schedules are at 10% of bloom, full bloom, at the end of the blooming period, and at the early fruiting stages. Persea mite (*Oligonychus perseae*) or white spider ("araña blanca," as it is called in Mexico), is gaining ground but appears to be more prevalent in warmer areas and in less healthy groves. The avocado seed weevil (*Conotrachelus perseae*) is said to be localized to certain warmer areas, below 5,500 ft. and mostly affects the local native varieties and other avocado varieties in poorly cared for groves. The insect lays its eggs on small to medium size fruit and the resulting larvae penetrate the fruit and work their way to the seed. The seed is the food source for the larvae, and often the seed is completely pulverized and destroyed. The infested fruit drops prematurely and the pupation stage takes place in the ground. The adult climbs the tree and feeds on leaves to complete the cycle, which occurs twice and sometimes three times a year with a life cycle of approximately 164 days. There has been a concerted effort to eradicate this pest. Dropped fruit in infested plots must be collected and burned and a variety of pesticides applied to both the trees and the ground are recommended. Infested fruit is seldom marketed since affected fruit tend to drop in early stages of development or its size is too small. The stem borer (*Copturus aguacatae*) is another devastating insect pest. The female bores small holes in terminal branches and lays one egg per hole. The emerging larvae bore tunnels along the interior of the branches in the beginning of pupation. Defoliation and

# HASS CULTIVATION IN MEXICO

continued from page 9

breakage of affected branches with fruit can result. At times the stem borer may also lay eggs in the fruit. There are two annual generations of the adult borer, from early June to mid-September, and from late December until early March. The removal of affected branches, which are later burned, is the best method to interrupt the biological cycle. This practice is one of the requirements imposed on Michoacan farms that export fruit to the U.S. Pesticides are also used, mainly Malathion and metallic Parathion.

Many other pests and humidity-related diseases are present throughout the region. These range from Amorbis and Omnivorous Looper to whitefly in the insect realm. A range of chemicals is used for the various pests, from Malathion and metallic Parathion, to Omite and sulfur, to Dipel, Benlate, Zineb and others. Diseases and disorders include anthracnose, ring neck and several manifestations of *Fusarium*. Cankers caused by *Fusarium* and *Phytophthora* are found throughout the region, especially in high temperature and humidity zones and in poorly ventilated groves. The cankers are commonly scraped clean and a paste of Bordeaux and Benlate is applied. This is being replaced by some farmers with a technique of poking holes four inches apart all over the infected area and applying to them, without the need for scraping, the Bordeaux-Benlate mix. (This practice is similar to the hole drilling in trees for the application of phosphorous acid formulations. The tool is 5/8 inch in diameter, screwdriver-size pointed poke, which is driven in an angle and stopping at the wood.)

Avocado groves are found on a variety of terrain ranging from flat to moderately steep hillsides. The Hass trees, grafted on Mexican seedling rootstocks, are planted in different spacings, either in squares or hexagonally. The recommended initial planting distance is either 16 by 16 ft. eventually thinned to 32 by 32 ft., or 22 by 22 ft. which is later thinned to 44 by 44 ft.

The Hass trees, in comparison to their native counterparts, are not as large. The tallest trees in thinned and well managed groves reach the height of

40-50 ft. and cover a radius of at least 15 ft. Fruit set in the better groves is tremendous, and what is limiting, in many cases, is the ability of the branches to support the heavy weight of the fruit. Many of the large trees are supported with metal cables, often a quarter to half-inch thick, strung from one major branch to the next. A crop load of 880 to 1,100 lbs. of fruit per tree is common in these quality groves, even in the cooler areas. The trees appear to be at their maximum potential for production. In at least one grove that I visited in 1995, many trees seem to have a set closer to 2,000 pounds per tree. The owner stated that he picked 2,970 pounds from one Hass tree. Fruit size, even with the high production, is acceptable by any standard. The breakdown is: 10% large fruit, ranging from 9.35 to 12.9 ounces; 50%-60% medium fruit, ranging from 7.4 to 9.35 ounces; and 30% small fruit, ranging from 6 to 7.4 ounces. There are other sizes at both extremes, but they are of minimal quantities.

The fruit from tall trees is picked by workers operating cherry-pickers, while others climb the trees, without ladders, and pick into picking bags which, when full, are lowered to the ground with ropes. It is not unusual to see three or four pickers working one tree. Picking poles are constructed differently, and only fruit designated for export is carefully picked in a fashion and with tools similar to what is common in California. The picked avocados are placed into plastic boxes each containing roughly 40 lbs. They are then transported to local packing-houses for processing and shipping. Fruit destined to the U.S. is packed in specially-designated packing facilities following the protocols outlined by USDA-APHIS. The average cost of harvesting and hauling to the packing-house amounts to 1.5 cents per lb., with a slightly higher rate for the fruit designated for export. Avocados for all markets are disinfected with a fungicide such as Thiabendazole, mainly to inhibit anthracnose. The avocados are graded and packed in wooden boxes for the local market, in 8.8 and 13.2 lbs. carton flats for export to Europe, and 25 lbs. lugs for export to the U.S. The Mexican market takes a mixture of sizes and grades in the same box, divided into small, medium, and large fruit.

Most of the fruit produced is sold in Mexico, where the demand is constantly increasing. There are over 85 million inhabitants in Mexico with a per capita avocado consumption rate that is the highest in the world, approaching 20 lbs. This market can absorb most of the Hass produced in Mexico, and could become a *de facto* importer of Hass which is the preferred variety by the Mexican consumer. Additionally, fruit with reasonable levels of oil content, not exceeding 25%, can end up processed by one of the several processors of pulp and guacamole. The market for processed products has increased rapidly in the last few years, and several retail outlets and fast food restaurants in the United States are purchasing large quantities of the products from Mexico. France and some Eastern European countries are also purchasing pulp and finished products. The Mexican product is made solely from Hass avocados, and over 100 million lbs. per year are being processed. There are several avocado oil processing plants in the area, but their business is limited mainly to the cosmetic industry.

To the student of avocado production, a visit to "Hass Heaven" is an experience that confirms that very high production could be defined and attained. It is a challenge to observe and learn the mysteries of these native lands of the avocado.

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