

Crop Profile for Coffee in Hawaii

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General Production Information

Hawaii's coffee industry is one of the most diverse and dynamic in the world. Current technologies and production practices span a range of producers from 1-acre, certified organic, rainfed farms to 4000-acre, totally mechanized, irrigated plantations (Bittenbender and Smith 2000). Even feral coffee, sown from the droppings of birds and pigs, is harvested from forests and long-abandoned farms on most of the inhabited Hawaiian Islands.

Coffee is a small evergreen tree that flowers on the previous year's growth. The tree has two distinct types of branches: *vertical* (orthotropic) and *lateral* (plagiotropic). The basic difference between vertical and lateral branches is growth habit. Verticals always grow up, produce laterals once at the leaf nodes and thereafter only new verticals at those nodes. Laterals grow horizontally and produce leaves, flowers, and new laterals. The fragrant white flowers are self-fertile producing red—or yellow fruit depending on the variety. The fruit, or 'cherries,' normally contain two seeds. After processing the seeds are called 'green bean' or 'green coffee', and can be stored for a couple years under ambient conditions. Coffee is roasted just prior to sale to consumers. Only then does it have the characteristic smell and color consumers expect.

- Hawaii and Puerto Rico are the only two places where coffee is grown in the United States. Production in Hawaii has grown from a decade low of 1.9 million pounds of green bean to 7.6 million pounds in 1998 (Anonymous, 1999). It has a farm gate value of \$24.7 million. A total of 7,400 acres are grown Islandwide (Hawaii, Kauai, Maui, Molokai, and Oahu). All coffee is arabica, *Coffea arabica*.
- Hawaii Island has 2,800 acres and more is being planted. Most acreage in Kona, home of world famous Kona coffee, is a 'Guatemalan' or 'Kona typica'. Coffee has been grown commercially for more than 170 years in Kona. Kona has a classic coffee climate, a dry winter punctuated by rains which result in flowering and a wet summer conducive to growth. Coffee grown on the island of Hawaii is not normally irrigated and is hand-harvested. Kauai Island has about 3000 acres, predominantly a modern Brazilian variety called 'Yellow Catuai'. Virtually all coffee is grown on one farm, the largest irrigated, mechanized coffee farm in the world. Molokai has one irrigated, mechanized 500-acre farm planted mostly to Red Catuai. Maui has one large irrigated, mechanized 370-acre farm planted to four varieties; Mokka, Red Catuai, Red Caturra and *typica* called Progeny 502. In addition there are several small farms on the slope of Haleakela volcano. Oahu has 170 acres of Guatemalan on one irrigated but hand-harvested farm.

- *Traditional Production.* Coffee is transplanted by hand at 6 to 12 months. Seedlings are pruned by hand annually to remove the oldest of 5 to 6 verticals. When the cherries are ripe they are hand-harvested. Each tree is picked several times over a 3-4 month period until all cherries are removed.
- *Mechanized Production.* "Mechanized coffee" refers to coffee grown utilizing mechanical cultural practices. These can include filling and seeding into paper pots, ground preparation, seeding of a temporary windbreak of Sudax® grass, laying plastic mulch and drip irrigation tube, transplanting, applying herbicides, irrigating, fertigrating, pruning, and harvesting.

Insect Pests

Hawaii is fortunate in that it does not have the most serious coffee insect pests found in other coffee-growing regions of the world. This is due to Hawaii's natural geographic isolation and quarantine regulations that restrict entry of coffee plants. Coffee can only be imported with a permit. It is subject to a one year holding period in a certified quarantine greenhouse.

Insecticides currently registered include: Safer's Insecticidal Soap Concentrate® (potassium, EPA Reg. No. 42697-1), Sun Spray Oil® (EPA Reg. No. 862-23), Valent Volck Supreme Spray® (EPA Reg. No. 59639-20) and Clean Crop Superior 70® (EPA Reg. No. 34704-35). The later two oils have Special Local Need labels in Hawaii.

Insect pests of coffee in Hawaii include Green scale, *Coccus viridis* and Black twig borer (coffee twig borer) *Xylosandrus compactus*. Several ant species nurse the scale and can sting pickers. A crab spider, *Gasteracantha* spp. is also a nuisance to pickers.

Green scale sucks sap from the coffee plant and excretes a sweet substance referred to as honeydew that covers the leaves and supports growth of a black sooty mold that reduces photosynthesis. Scales require constant attention when the trees are young and growing, particularly in dry areas or dry seasons. Unless scales are controlled, coffee trees will become stunted and sometimes die. Spraying either an oil or soap emulsion according to label directions controls green scales.

The most successful biological control agent against the scale is the white halo fungus (*Verticillium lecanii*) introduced from Florida around 1910. It destroyed millions of scales in Kona during the more humid periods of the year. However, it requires high humidity and free water to reproduce. It is active only in wet season such as Kona in the summer or in areas with relatively high rainfall. It is not effective

in the mechanized, irrigated coffee areas on Maui, Molokai, Oahu, or Kauai.

Black twig borer, a type of ambrosia beetle, is not usually a serious pest, although infestations on individual farms can be severe. The tiny brownish-black, cylindrical beetle was first found in Hawaii in 1961. It attacks both the lateral and vertical branches. Besides coffee, it infests over 110 hosts including avocado, cacao, mango, macadamia, hibiscus, tea, orchids, anthurium, and other ornamental and forest trees and shrubs. This wide host range makes it especially hard to control. Typical symptoms of black twig borer are wilting and death of leaves and wood beyond the beetle's entry hole. The wilted leaves and bark beyond the affected area turn black. Although a single beetle may kill a twig, several beetle burrows are required to kill a lateral. On thicker verticals, even heavy infestations do not always kill the branch.

Pregnant females bore into the twig to make a tunnel for eggs and provide a protected habitat for the larvae. Females cultivate a fungus, *Fusarium solani*, within the tunnel to feed the larvae. This fungus produces a toxin that kills the twig and leaves beyond the entrance hole. Infested laterals should be pruned behind the last entrance hole as soon as wilting is observed to prevent new adults from emerging, usually a matter of a few weeks. Pruned laterals must be immediately (the same day, if possible) chipped, burned, or buried to kill the beetles and larvae (Jones and Johnson 1996).

This beetle generally attacks trees weakened by drought, girdling, heavy pruning, standing water, or lack of fertilizer. Some coffee cultivars are more susceptible than others. The best control is by maintaining healthy trees since no insecticide registered for coffee is effective against this pest.

Diseases

Cercospora leaf spot or brown eyespot, *Cercospora coffeicola* is found in coffee-growing areas worldwide. It is common in Hawaii but not economically important. Good growing conditions, sufficient air circulation, adequate fertilization, and irrigation are necessary to prevent the disease from becoming established. However, drought can render trees susceptible to this problem when growth resumes. Copper fungicides, (Clean Crop and Kocide (EPA Reg. Nos. 55146-1-34704 and 1812-338, respectively) are only necessary in a serious outbreak. Symptoms appear as small chlorotic spots that expand to 3/16–5/8 inch in diameter on leaves. The outer portion of the leafspot becomes brown; the center becomes gray-white. The spot's eye-like appearance distinguishes it from other leafspot diseases. Spots can occur on the cherries, appearing as sunburn, a black, dried, elliptical scar on the skin. These make the cherry difficult to pulp and may reduce the green bean quality. After flowering, high humidity, rain, warm temperature, and drought stress favor the disease. Exposed, unshaded trees and nursery seedlings are most susceptible.

Nematodes

Coffee nematode decline caused by Kona coffee root-knot nematode (*Meloidogyne konaensis*) is a serious 'disease' of coffee. So far it is found only in the Kona region. Infested trees are stunted or poorly growing. Sometimes stunting occurs in a cluster of trees. Nematode entry and feeding within roots disrupts plant growth processes and causes growth decline. Symptoms are drooping leaves, later wilting, leaf loss, and wobbly, loosely anchored trees. Roots have a swollen, corky appearance with few small roots alive (see Schmitt 1996, Serracin et al. 1999).

Avoiding the problem requires transplanting with nematode-free plants in nematode free fields. Tolerant rootstocks are also used to minimize nematode damage. Limited amounts of *C. dewevrei* seed is available to growers or nurseries for growing mother trees to produce seeds for rootstocks, although buying grafted plants is recommended.

Nematicides are not effective in controlling the problem and none are registered. Some preplant soil fumigants are registered, Nemasol and Vapam (both metam sodium, EPA Reg. Nos. 34704-647 and 10182-150, respectively).

Weeds

To obtain good coffee yields, weeds must be controlled, regardless of the pruning system or degree of mechanization. Newly transplanted coffee is particularly sensitive to being shaded out by fast growing weeds. Among the important weeds affecting mature coffee are vines. In particular, coffee grown in hedgerows on mechanized, irrigated farms in dry areas are impacted by morning glory, ivy gourd, bittermelon, and *maile pilau*. Volunteer coffee seedlings are a particular problem in mechanically harvested orchards. Guinea grass and California grass are problem grasses under any system.

Controls include mowing, plastic mulches, herbicides, and even ducks. Ducks have been used on some organic farms which maintain clean cultivation on the rocky, *a'a* lands of Hawaii Island. Mowing is feasible if the orchard floor is properly prepared by removing rocks and uneven sections. Planting a cover crop to produce a uniform groundcover and will increase the efficiency of mowing. Allowing volunteer groundcovers and keeping them mowed is a common practice that works well only if there are no vines to tangle in the mower or climb the coffee trees. Undesirable weed species that occur in volunteer groundcover should be mown or otherwise controlled before they produce seed.

Postemergence herbicides are widely used. Roundup® (glyphosate, EPA Reg. No. 524-445), a systemic herbicide, is effective against most annual and perennial weeds. However, it may kill the coffee plant if

allowed to contact coffee leaves or green stems. Gramoxone® (paraquat, EPA Reg. No. 10182-280), is a contact herbicide effective against many annual weeds. It will also damage coffee leaves and green stems and is used as part of mechanized pruning to remove excess verticals or "suckers." Gramoxone is a Restricted Use Pesticide that may only be applied by or under the direct supervision of a certified applicator.

Orchards in dry areas rely heavily on paraquat and glyphosate. Their efficacy against a wide range of weed species and growth stages allows flexibility regarding the timing of application. The effect of glyphosate can be enhanced by mixing it, according to label directions, with ammonium sulfate or a postemergence herbicide called Scythe® (pelargonic acid and related fatty acids C6-C12, EPA Reg. No. 53219-7).

Fusilade DX (fluazifop-P-butyl, EPA Reg. No. 10182-367) is a systemic herbicide effective against certain annual and perennial grasses. It may only be used in Hawaii. No more than 48 fl. ounces can be applied per acre per growing season. However, it can be applied up to one day prior to harvest. Applicators are prohibited from applying it if rainfall is expected within one hour of application. In irrigated orchards, Fusilade must be applied within seven days after irrigation.

Pre-emergence herbicides are used less frequently. Pre-emergence herbicides prevent weed seeds from sprouting. In newly established coffee orchards, they are sprayed beneath trees in rows between mown groundcover alleys to minimize maintenance costs. Mowing and use of selective herbicides are usually needed to maintain groundcovers.

Goal 1.6E® (oxyfluorfen, EPA Reg. No. 707-174) controls certain annual broadleaf weeds, but continual use encourages perennial broadleaf weeds. Surflan (oryzalin, EPA Reg. No. 62719-112) controls certain annual grasses and broadleaf weeds.

A number of groundcover species can be used in coffee. In Kona, a dwarf "wandering Jew" (*Zebrina pendula*), a relative of honohono (*Commelina diffusa*) grass is used. Orchard grass (*Dactylis* species) is also common.

Several species of groundcovers have been evaluated by CTAHR for dry areas. None are in wide use yet. Drought-tolerant perennial grass cover crops 'Tropic Lalo' (*Paspalum hieronymii*), Rhodes grass (*Chloris gayana*), Klinegrass (*Panicum coloratum*), buffel grass (*Cenchrus ciliaris*), and possibly bermudagrass (*Cynodon dactylon*) are well adapted to low-rainfall areas. Research suggests that narrowleaf carpetgrass (*Axonopus affinis*) and perennial peanut (*Arachis pintoi*) are not good for planting in dry conditions as they are slow growing and do not provide rapid protection of soil or suppress weeds in their early stages. Perennial peanut should do well if irrigated to establish or planted at the beginning of the rainy season.

Small grains, such as ryegrass (*Lolium multiflorum*), oat (*Avena sativa*), and rye grain (*Secale cereale*), were evaluated as temporary cover crops for protecting the soil during the rainy season from November

to April (in areas other than Kona). This is generally the most erosive and weedy period of the year. Grasses die out during the summer months. This may be an attractive option for plantations that face summer water shortages and have concerns about competition for water between the coffee and the cover crop.

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