

# Crop Profile for Pineapples in Hawaii

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## General Production Information

- Hawaii ranks first in national production of pineapple in the United States.
- Hawaii contributes 100% to total United States production of pineapple (excluding the territory of Puerto Rico).
- In 1998, 21,000 acres (8,505 ha) were planted in pineapple which yielded 332,000 tons (301,124 Mg). The farm value is estimated at \$92.8 million. Processed fruit had a farm gate value of \$131/ton (\$119/Mg). Fresh market sales averaged \$575/ton (\$522/Mg).
- Pineapple production costs are estimated at \$12,000/ac (\$29,630/ha) to establish the crop and produce the first harvest (18 months).
- Fresh fruit represented 33% of pineapple production and sales. Pineapple processed for canning or juice accounted for the remaining 67%.

## Production Regions

Pineapple is produced primarily on the islands of Oahu and Maui. Some small scale production is found on Kauai and the island of Hawaii. Pineapple is grown at elevations ranging from sea level to below 800 m (2800 feet) with mean annual temperatures ranging from 18.5° to 26°C (65° to 79°F).

## Cultural Practices

Pineapple is grown on almost any type of soil, but the crop is especially well-adapted to acid soils. When soil pH is between 4.5 and 5.5, soil-borne diseases are reduced. Field practices for pineapple are highly mechanized, except for planting and harvesting where manual labor is used. All other field operations, i.e. land preparation, fertilization, pest control, are done by machine.

Once the final crop is harvested, old plants are disced, left to dry, and then burned or plowed into the soil. Soil preparation usually includes plowing with a moldboard plow to a depth of 18 to 24" (45 to 60 cm), followed by disking. Disking breaks up soil clods to assure that soil fumigants used to control nematodes penetrate throughout the soil. After tillage, a preplant fertilizer consisting of N, P, and K are

applied, a fumigant to control nematodes is injected into the soil, and plastic strips are laid over the fumigated area, all by one machine. All P and most of the K is applied prior to planting. The plastic mulch serves to mark the plant location, retain the fumigant, control weeds, and raise soil temperature.

New fields are established from vegetatively propagated material, typically crowns although slips and suckers may sometimes be used. Cultivated types of pineapple are classed in four or five groups including 'Cayenne', 'Spanish', 'Queen', and 'Pernambuco'. Commercial production in Hawaii is mostly based on strain selections from field populations of 'Smooth Cayenne'. Planting material usually is dipped in a fungicide or dried for several days prior to planting to reduce the incidence of rot. Planting is done by hand with from 59,000 to 74,000 crowns or other propagules planted per hectare (24,000 to 30,000 crowns per acre).

Water is applied by overhead boom spray or sprinkler to help establish the planting material if no rains are likely. In the drier areas of Maui and Oahu, drip irrigation helps to maintain growth rates. Water is applied approximately once weekly for a total equivalent to 60 cm/year.

Nitrogen, as urea or urea-ammonium nitrate, iron, and zinc are commonly applied after planting. All nutrients applied after planting are applied by a boom spray truck or with the irrigation water. A urea, iron, and zinc solution is applied every ten days to two weeks beginning about three months after planting until fruiting is initiated.

Flower initiation occurs naturally on short, cool days. Consequently, artificial induction of flowering with chemicals, called "forcing," is conducted through out the year when plants are large enough (usually at least 1.5 kg fresh weight). This permits scheduling of planting and flowering so that harvests can be spread throughout the year. It is also used in "closing out" the crop to assure a complete and synchronous change at the time of natural flowering.

Pineapple is ripe when the individual eyes become flattened and glossy and when shell color turns yellow to yellow-orange. Color development starts at the base and moves toward the top. In Hawaii, pineapple is harvested when about one-third yellow for canning and when mature green for fresh fruit. Harvesting before ripening increases postharvest storage life, although harvesting when ripe is preferable for best fresh fruit quality.

## **Insect Pests**

Pineapple has relatively few insect pests. Scales (*Diaspis bromeliae*, *Melanaspis bromeliae*) and symphylids (*Scutigrella sakimurai*, *Hanseniella unguiculata*) are seldom serious pests in pineapple. Scales, a cosmetic problem on fresh fruit, are only problems in some fields during some growing

seasons.

**Thrips** (*Thrips tabaci*, *Frankliniella occidentalis*) are vectors of the Yellow Spot Virus. Thrips are seldom of serious economic concern in pineapple. Mites (*Steneotarsonemus ananas*, and *Dolichotetranychus floridanus*) are seldom serious problems.

**Mealybugs** (*Dysmicoccus brevipes*, and *D. neobrevipes*) and the ants (*Pheidole megacephala*, *Iridomyrmex humilis*, and *Solenopsis geminata*) which tend them are associated with the very serious mealybug wilt disease. Mealybug wilt can occur if mealybug populations become high. Entire fields, up to 50% of the plants in a field, can be lost if control is not undertaken. Most often the ants are controlled which allow natural predators to keep the mealybug population in check.

#### Chemical Controls:

An effective ant control program makes it possible for the mealybug to be kept under control by predation by natural enemies. Ant control costs usually are less than those incurred in controlling mealybugs. Preplant application of Amdro (1.7kg/ha) is made to the perimeters of newly planted pineapple fields (2,500 ha). Amdro is also applied postplant at 1.7kg/ha to approximately the same number of hectares. Diazinon is applied once or twice to a few fields (22%). Diazinon may also be added to the preplant dip if scales or mealybugs are present in the planting material.

Most all insecticide applications are based upon IPM programs. Applications are not made unless the field has had a history of problems or the growing conditions favor insect development. Some growers employ threshold levels to treat.

#### Cultural Control Practices:

Vegetation in gullies and roadsides provide a reservoir for mealybugs and the ants. Eliminating alternative weed hosts of the mealybugs abutting pineapple fields can reduce the reservoir. However, this is impractical and nearly impossible to do.

#### Biological Controls:

Natural predators of the mealybugs have been introduced and are well established. With control of the ants, these natural predators keep the mealybug population in check and reduce disease pressure. However, without elimination of the ants, natural predators are an ineffective control of the mealybugs.

#### Other issues:

Preharvest intervals are often not a problem in pineapple because of the plant cycle. Plants grow relatively slowly, requiring 6 months from flower initiation to fruit harvest. It is relatively easy to stop pesticide applications well before harvest and still achieve acceptable yields.

Current research is attempting to mass propagate and release mealybug predators. Augmentation of predators may reduce or eliminate the need for insecticides. The results of this research are perhaps 10 years from commercial application.

## Diseases

Diseases of pineapple include plant as well as fruit problems. A heart and root rot is caused by *Phytophthora cinnamomi*. *Phytophthora parasitica* also causes a heart rot of the plant. Some root rots are caused by *Pythium* spp. Butt rot, caused by *Thielaviopsis paradoxa*, can be a devastating problem for newly planted material. Black rot of pineapple is caused by *Ceratocystis paradoxa*. These diseases are dependent upon favorable environmental conditions and are generally limited to only certain fields. Several years may pass before a serious epidemic occurs.

Pineapple wilt is a serious disease. Disease occurs only in association with a mealybug and a closterovirus (PMWaV). Mealybugs can transmit the virus. Neither the virus nor the mealybug alone incites mealybug wilt. The virus occurs in high frequency in some clones that are planted. Other clones have a lower frequency of virus infection. Mealybug wilt is controlled by controlling the ants that tend the mealybugs. Yellow spot virus (tomato spotted wilt virus) also occurs in pineapple but is not usually a severe problem.

Bacterial diseases caused by *Erwinia carotovora* and *E. chrysanthemi* can be problems of the fruit but are not common. Fruitlet core rot, incited by *Penicillium funiculosum* and *Fusarium moniliforme* var. *subglutinans*, is problematic sporadically. The disease affects the quality of the fruit and is detected after reaching the consumer. Pink disease of the fruit is caused by *Acetomonas* spp. and is only a problem in canned fruit. While some losses due to fruit diseases occur, they are not large enough to justify the costs of control even though annual losses may reach a few million dollars.

### Chemical Controls:

Fungicides are used to control diseases primarily associated with root and butt rots. Postplant applications of fungicides are used only when disease pressure is high and in fields where disease is most likely to occur. Eight products are registered representing four different active ingredients. However, only Fosetyl-Al is used generally. It is applied as a preplant dip to all planting materials. The product is mixed at 0.002 kg/ and 100% of the crowns planted each year are dipped. Benomyl is sometimes added to the dip treatment if butt rot problems are occurring. Fosetyl-Al is also applied at 2.25 to 3.4 kg/ha on a relatively small amount of the pineapple acreage as a postplant broadcast treatment when disease pressure is high. More fungicides may be required in very wet years.

The approach to fungicide treatment follows an IPM approach. Except for the treatment of planting material, fungicide applications are made only in areas with a history of problems and then only when environmental conditions favor disease development.

### Cultural Control Practices:

When soil pH is between 4.5 and 5.5, soil-borne diseases are reduced. Soil pH greater than 7.0 should be avoided. Good soil drainage is a necessity. Where rainfall is high or soils are not well drained, soil management techniques such as ridging must be used to improve drainage.

Planting material that is cured before planting has less butt rot problems. Crowns and slips can be exposed to the sun for several days before planting.

Maintaining weed free areas around fields reduces inoculum and therefore disease problems.

#### Biological Controls:

No biological controls are used against diseases in pineapple to date.

#### Post Harvest Control Practices:

Fields are fallowed from 3 months to 1 year. Little weed growth occurs during the fallow periods keeping inoculum levels low.

#### Other issues:

To prolong shelf life, fungicide dips may be used on the fresh fruit.

Host plant resistance to several pathogens has been identified in pineapple or its close relatives. Multigenic resistance exists to *P. cinnamomi* and *P. parasitica*. Resistance to pink disease is also available. However, a long breeding program was unable to develop desirable hybrid cultivars. Much indirect selection by the growers has resulted in greater levels of tolerance to many diseases in the currently planted Smooth Cayenne clones.

## Nematodes

*Rotylenchulus reniformis* and *Meloidogyne javanica* are the major nematode pest of pineapple in Hawaii. These nematodes infest nearly all fields. Nematode damage is manifested in a wider fruit size distribution, uneven flowering, and smaller fruit overall. Plant crop yield can be reduced by 60% to 74% by nematode infection damage to the first ratoon crop can range from 40% to 45% lose in marketable yield. Nematode control is achieved by preplant operations as well as postplant chemical treatments. There are 10 products registered for nematode control in pineapple. Nematicides comprise the largest (by weight) category of pesticides used in the pineapple cropping system

#### Chemical Controls:

The two main preplant chemicals used are the fumigants 1,3-dichloropropene and methyl bromide. 1,3-D is applied between 224 to 336 /ha to approximately 63% of hectares planted each year. Methyl bromide

is applied to fewer hectares. Only 37% of planted area is treated each year at 134 kg/ha. Nematicides are also applied postplant either as overhead broadcast sprays or using a chemigation procedure. Fenamiphos is the main product used and applied at between 6.2 - 9.3 /ha to approximately 10% of the hectares under cultivation.

Biologically derived products, such as DiTera or Sincocin, have been evaluated and may provide alternatives to the organophosphates currently used. In general, the biologically derived products have not achieved the level of control need to economically control damage.

#### Cultural Control Practices:

Little can be done to control nematode damage once the crop is growing. Sufficient water and fertilizer can help the plants to compensate for some nematode damage but not all. Often in pineapple it is the second and third harvests which are most adversely affect

#### Biological Controls:

Several biological controls have been investigated during the past 30 years. Organisms such as *Paceliomyces* and *Pastueria* have not been able to control the nematode populations.

#### Post Harvest Control Practices:

Incorporation of organic matter after crop knock down and fallowing fields can reduce nematode populations to levels below the damage threshold. Relatively long fallows, greater than 6 months, are needed to reduce nematode populations to these levels, however. Short fallow periods or fallows where volunteer pineapples occur often are insufficient in reducing nematode population levels, necessitating additional methods of control.

#### Other issues:

Nonchemical alternatives, such as cover crops or soil solarization, are currently not as effective as fumigation. Research is underway to find cover crops which can enhance soil microorganism antagonistic to plant-parasitic nematodes. Host plant resistance is not available in pineapple or closely related species. Difference in tolerance to the nematode exist among clones and cultivars with Smooth Cayenne clones showing the greater tolerance than other cultivars.

## **Weeds**

Weeds can have devastating effects on pineapple yield. Under severe weed problems, plant crop yield can be reduced 82% to 83%. To control weeds in bare soil areas between the mulch beds, herbicides cleared for pineapple may be used according to the instructions on the label. Some herbicides are applied as overtop sprays immediately after planting and at later stages during the crop cycle.

Herbicide alternatives, such as hand weeding or tillage, are employed in pineapple after the canopy has closed. Hand weeding is costly because of high labor cost. A plastic mulch laid during field preparation assists in fumigant retention, water management, soil temperature control, and weed control but prohibits tillage.

#### Chemical Controls:

Four products are applied preplant for weed control. Ametryn is applied at 0.56 - 2.24 kg/ha on 100% of the pineapple planted each year. Bromacil and Diuron are applied at similar rates on all newly planted fields. Hexazinone is applied at between 0.34 - 2.24 kg/ha to newly planted pineapple.

For postplant weed control six herbicides are commonly used. Applications are broadcast over the top of the pineapple crop. Fusillade is applied at 1.2 ml/ha to approximately 2% of the crop acreage. Ametryn is applied at preplant rates to most of the pineapple acreage (97%). Quicalofop-p-ethyl is applied at 1 to 2 /ha on 0.5% of the acreage. Bromacil and Diuron are applied at 0.6 to 2.25 kg/ha over nearly all of the pineapple acreage before the plant canopy closes. Glyphosate is applied at 4.5 /ha to approximately 6% of the pineapple acreage. Once the canopy has closed at about 12 months herbicide applications generally cease.

#### Cultural Control Practices:

Weeds are controlled within the bed by black plastic mulch. The plastic mulch laid during field preparation, however, prohibits tillage as a weed control method. Hand weeding is employed after canopy closure.

#### Biological Controls:

No biological controls are used against weeds in pineapple to date.

#### Post Harvest Control Practices:

Fields are fallowed from 3 months to 1 year. The fields are deep moldboard plowed to bury weed seeds and prevent soil erosion. Little weed growth occurs during the fallow periods. Fields are not irrigated during fallow periods.

#### Other issues:

Weed control is not viewed as a major problem by the producers. The current standard practices work well. Pineapple land is not rotated to other crops and the pineapple seems to be tolerant to many herbicides reducing concerns about carry over problems.

Current research is investigating the use of living mulches to control weeds, eliminate the plastic mulch, and reduce irrigation requirements. This research is several years away from practical application.

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