

Lecture 30 Pineapple

Pineapple: *Ananas comosus*, Bromeliaceae



Historical

Pineapple is one of the most delicious of tropical fruits. It was domesticated in pre-Columbian times in South America (Paraguay and the Amazon) when seedlessness mutants were established.

The Tupi (Indians of Brazil) name for the plant is "nana."

The pineapple was found by Columbus in Guadeloupe.

He described it as follows:

"fruits like artichoke, four times as tall, fruit in the shape of a pine cone, twice as big, fruit is excellent and can be cut with a knife like a turnip and it seems to be wholesome."

First known reproduction of the pineapple, 1535



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Pineapple was grown in Europe in heated greenhouses as a delicacy of royalty and was grown in England as early as the 18th century.

Now widely grown in the tropics and subtropics.

The greatest exploitation was in Hawaii but industry has moved to the Philippines and Taiwan because of high labor costs.

The industry in most of the 20th century was processed pineapple but now fresh pineapple is increasing.

In Brazil the name for pineapple is *abacaxi* which is also used the same way as the slang expression *lemon* in Americanese.

Uses

Fresh fruit

Canned (slices, chunks, diced, juice)

Frozen

Dried

Jam, glacé

Alcohol and sugar syrup

Fruit residue (bran) is used as a cattle feed

Leaf fiber produces piña cloth in Philippines

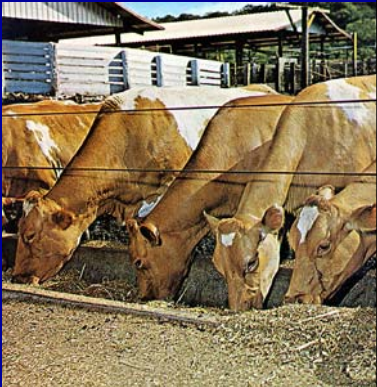
Variegated forms are grown as ornamentals

Source of bromelain, protein digesting enzymes
(meat tenderizer) from stump




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Bran from dried fruit shells and hay from plant leaves used for cattle feed are only two of a number of pineapple by-products.





Selling pineapple, Belo Horizonte, Brazil



Belo Horizonte, Brazil

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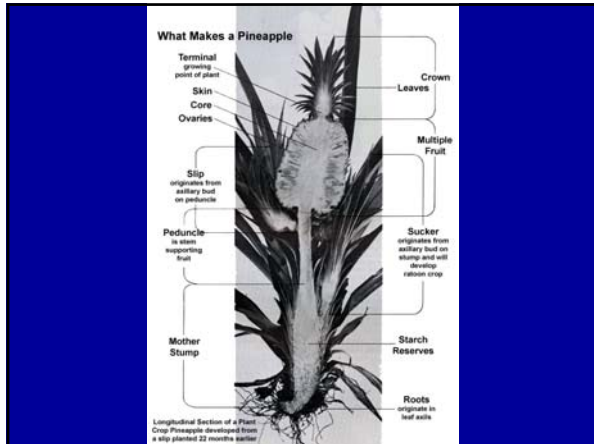
Pineapple Production (2001)		
Continent	1000 tonnes	Chief countries
World	13,739	
Africa	2,229	Nigeria (881), Kenya (280), Ivory Coast (226)
North America	1,512	Mexico (535), Costa Rica (475), Dominican Rep. (137)
South America	2,556	Brazil (1,442), Colombia (360), Venezuela (300)
Asia	7,275	Thailand (2,300), Philippines (1,572), China (1,284)
Europe	2	Portugal (2)
Oceania	164	Australia (140), Papua New Guinea (12), Samoa (6)



Morphology

- Plant is a herbaceous, perennial, monocot.
- Plant is very tough.
- Very efficient in water use, stomata are on the underside of the leaf and open only at night.
- Thus plants can resist desiccation.
- There is a tremendous amount of plant material when crop is mature.
- Need very heavy machinery to plow up fields.

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Terms Used in Pineapple

Axillary bud: Bud formed in leaf axils.
Crown: Shoots from apical end of fruit.
Ground sucker: Basal leafy shoot from axillary bud.
Hapa: Slip at base of peduncle.
Multiple fruit: A collection of fruits comprised of individual fruitlets.
Peduncle: Fruit stalk.
Ratoon: Suckers bearing second or successive crops.
Sucker: Leafy shoot from axillary bud.
Slip: Leafy shoot from peduncle.
Starch reserve: Starch stored in the stalks.

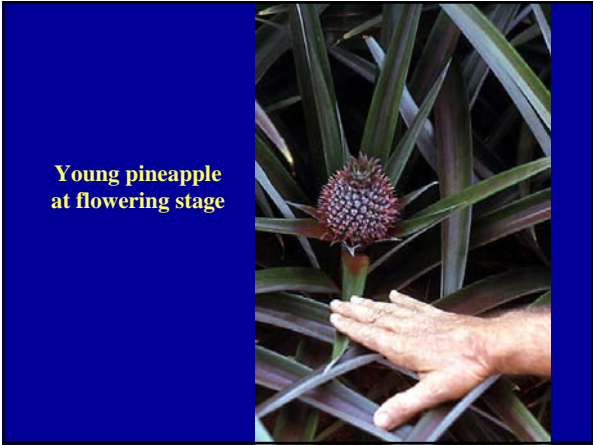
Pineapple is a multiple fruit.

After this flowering stage each floret becomes part of the single fruit.

Flowering takes two weeks.

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Ecology

Pineapples grow best with average temperature of 60–61°F.

Very little resistance to frost.

Temperatures of 50°F produce injury symptoms (tipburn, purple color induction in leaves), and lower temperature hasten flowering however but temperatures of 40°F for 48 hours will injure fruits.

Fruits of plants grown in shade are juicier and less yellow, lower in sugar; poorer quality.

Sandy loam soils are ideal, acid soils, 5.0–5.5 pH are optimum.

Zinc deficiency is prevalent in Hawaii.

Propagation

Crowns, slips and hapas, suckers, butt or stump are important means of propagation.

Plant can also be propagated by tissue culture.

As a seedless plant, seeds are only used for propagation in breeding.

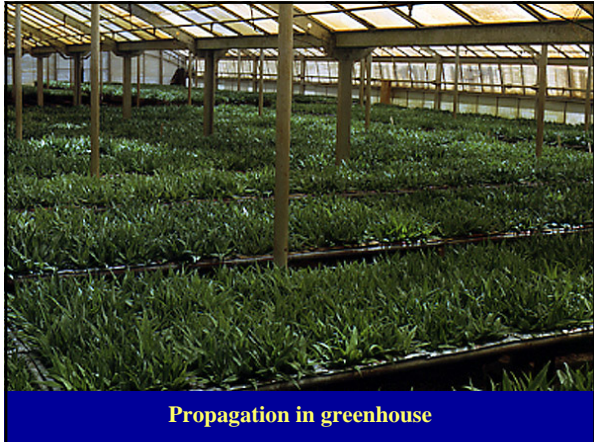
The first crop from a propagule is called the plant crop; subsequent crops are called ratoon crops (i.e. 1st ratoon, 2nd ratoon etc.)

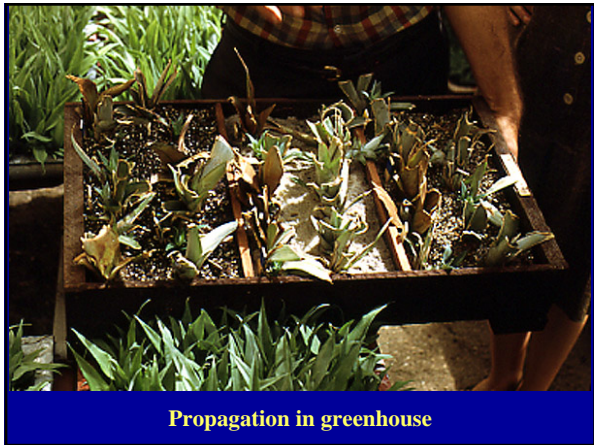
The rate of propagation is slow in conventional propagation.

Crown



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'Smooth Cayenne' typically provides only two propagules per plant per year.
Thus, it would take 20 years to plant 1 hectare (2.47 acres) from a single plant.
This is because 'Smooth Cayenne' selections contains few slips.
It is possible to also propagate from axillary leaf buds and stem sections in the greenhouse.
Tissue culture propagation can be very rapid.

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Crop Cycle

Usually a four year crop cycle: a plant crop and one ratoon crop, with 6-9 months for land preparation.

Soil fumigation has been important.

In the past DD (1-3 dichloropropene + 1-2 dichloropropane) was used but this technology is rapidly changing due to environmental concerns.

After planting paper or plastic mulch is spread.

With shoots, slips, or crown propagules the typical plant population is 40,000 to 45,000 plants per acre (often using triangular planting patterns).

Plants are set through the paper or plastic mulch which is applied first.

Typical crop density is 17,400 plants/acre using double rows, with spacing 22" x 12" and 5' spacing between double rows.

Fruits decrease 1/10th of a pound from every 1000 plants/acre above this population.

Cannery size is typically 4-1/2 to 5.0 lb. per fruit.

Heavy fertilization is required.



Pineapple is planted through rows of mulch paper to conserve moisture and improve plant growth.

Paper is laid by machines which fertilize and fumigate land beneath.

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Plants initiate flowers when temperatures are low.

In Hawaii there are typically two times of flower initiation, June (when temperatures are not low) and December.

However, flowering is erratic and thus harvest may not be synchronized.

To produce synchronized flowering to allow scheduling in factories flowering can be induced by a number of techniques.

This includes smoke (an ethylene effect), ethylene, acetylene, and growth hormones [10–100 ppm naphthaleneacetic acid (NAA)].

Indoleacetic acid (the native auxin occurs in large quantity in pineapple, and inhibits flowering.

NAA, IBA, 2,4-D when applied lowers the effect of the native auxin and increases flowering.

Ethylene, acetylene, BOH (beta hydroxyethyl-hydrozine) lowers natural IAA through oxidation to increase flowering.

NAA (sodium salt), is very effective in forcing flowering.

Ethylene and ethylene-releasing compounds such as ethephon [(2-chloroethyl) phosphonic acid] is very effective.

Calcium carbide, (1 granule dropped in leaf axil) produced ethylene when it comes in contact with water to produce acetylene.

Harvest

Crop is hand harvested but assisted by machine which collects fruit into large hampers.

Fruit yields of 40 tons per acre can be obtained.

The first ratoon crops has lower yields 30 t and fruit size is smaller.

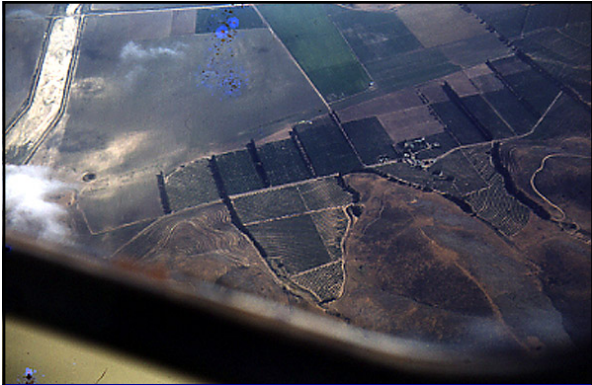
After terminal harvest is complete there is tremendous residue left in the field.

All plant residue is plowed up during land preparation.

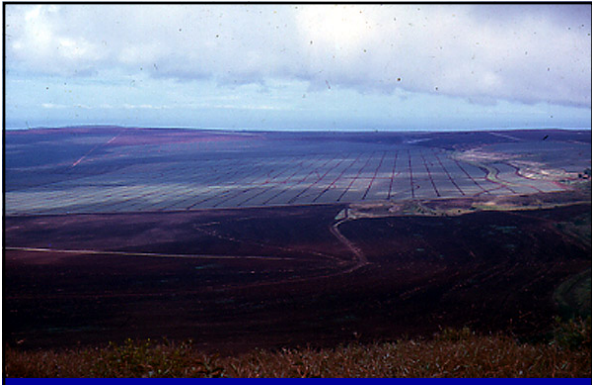
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Pineapple in Brazil (termite nests)



Hawaii pineapple



Hawaii pineapple

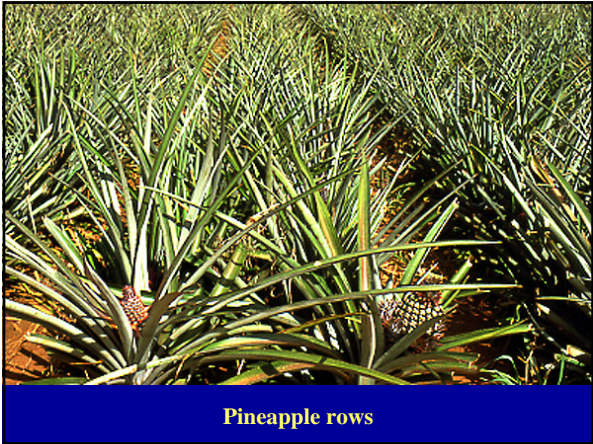
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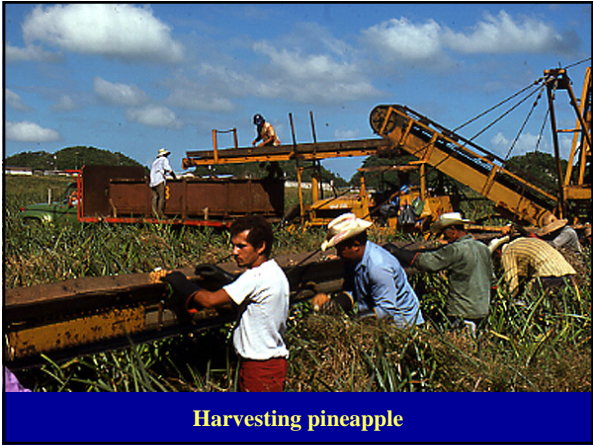




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Mechanical harvest, Puerto Rico



Harvesting pineapple



Harvesting pineapple

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Cultivars

'Smooth Cayenne', a spineless mutation of 'Cayenne' has been the standard processing cultivar.

It has large tough fruit and is well adapted to the Ginaca machine which peels the fruit.

Pineapple production in Hawaii was controlled by Dole Corporation which is a highly mechanized, shipping company and machine adaptation was the most important characteristic.

Flesh is pale yellow to yellow and sugar and acidity of fruits is high.

'Smooth Cayenne' is best adapted to processing because fruit is blocky and there is a high yield of slices, which are the most valuable product.

However, Hawaii has lost the processing industry, and is shipping 'Smooth Cayenne' as a fresh fruit but quality is not as high as other cultivars.

'Queen' has gold yellow fruit color, crisper flesh, pleasant aroma and flavor, and less fibrous than 'Smooth Cayenne'

Good for fresh fruit.

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'Singapore Spanish' is grown in Malaysia; leaves are smooth and plants are smaller but fruits are the same size as 'Cayenne'.

Flesh color is golden but more fibrous than Cayenne; good processing type.

'Red Spanish' Intermediate in plant and fruit production between 'Cayenne' and 'Queen'.

Fruits are small, color not as yellow as 'Queen'. Blossom cup is deep.

'Del Monte Gold': New yellow-fleshed pineapple is taking over the fresh fruit market.

A seedling produced at the Pineapple Research Institute (litigated now by Del Monte and Dole)





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Breeding

Breeding programs had been unsuccessful until development of Del Monte Gold (MD-2).

Most of the improvements have come about from selection of natural variation, a type of mutation breeding.

Selection criteria include:

Spineless leaves.

High slip production with slip attached to peduncle not to fruits; "Collar-of-slips" is a serious defect.

Good sucker production.

Upright sucker types.

Disease tolerance.

High yellow pigment in the winter.

Square shoulders rather than pyramidal shape to increase slice production in cannery.

Single crown.

Small core (core is an extension of peduncle).

Medium sized eye.

Uniformity of ripening in each fruit.

Flat abscission zone.

High Brix (soluble solids or sugar content) and good sugar-acid ratio.

Yellow-flesh for fresh fruit market.

This huge water tank, "the largest pineapple in the world," has long been a symbol of Hawaii's great industry.

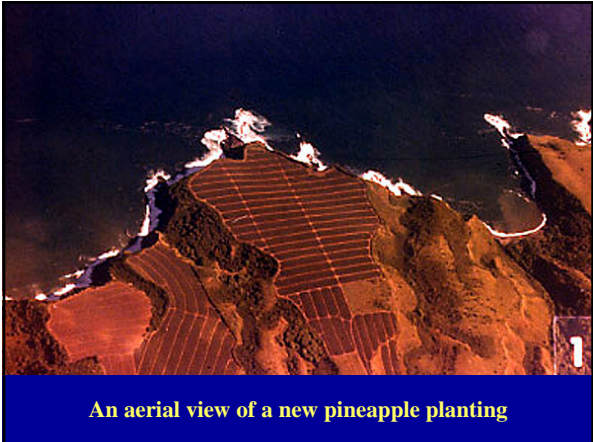
It loomed above the Hawaiian Pineapple Company's Honolulu plant.



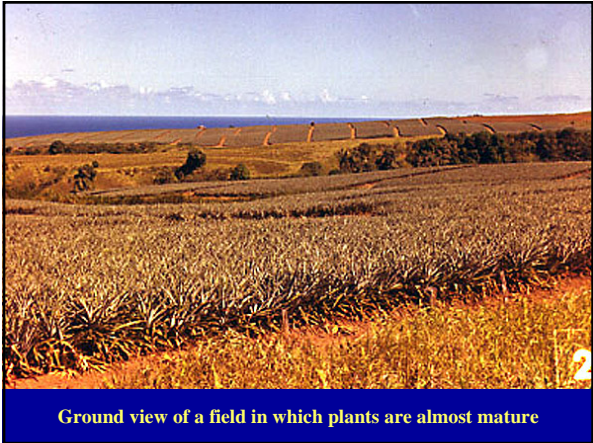
1927-1993



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An aerial view of a new pineapple planting

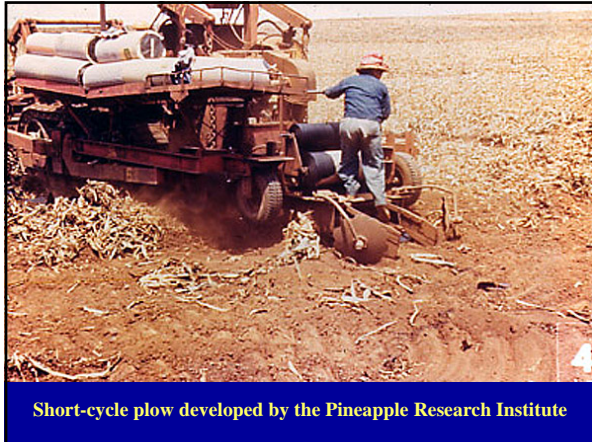


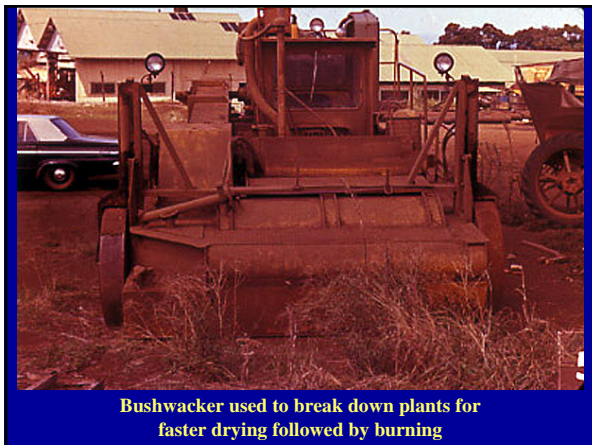
Ground view of a field in which plants are almost mature



Field being disced in order to knock down old plants

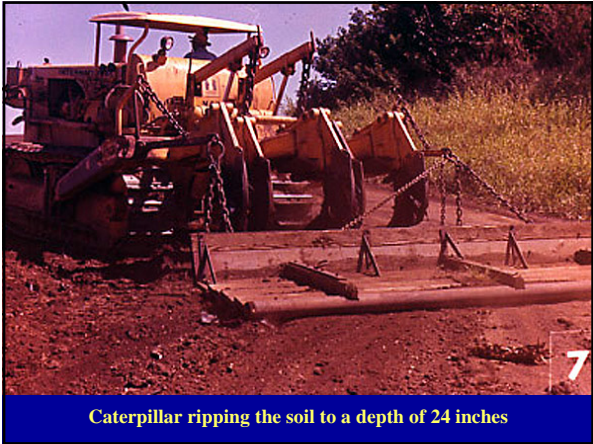
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Caterpillar ripping the soil to a depth of 24 inches



Sled follows in order to leave the field smooth

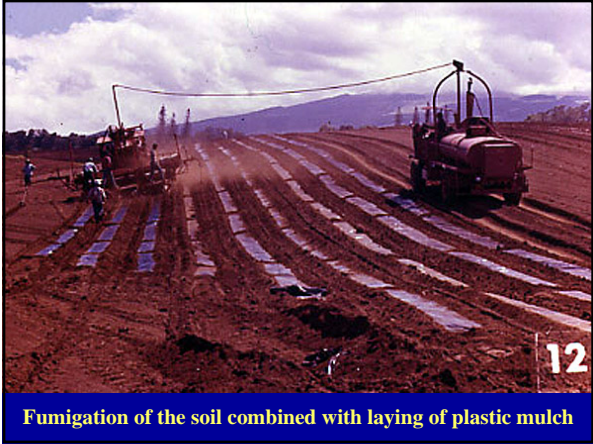


Injecting fertilizer into the soil prior to planting

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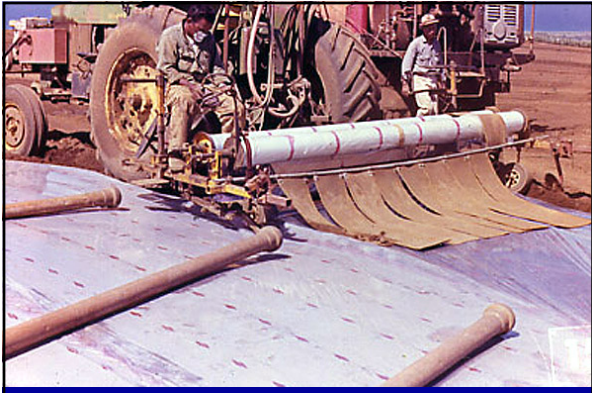
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Laying of plastic mulch



Experimentation of full coverage mulching

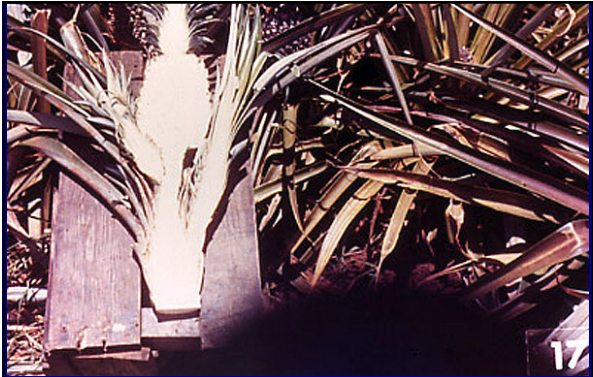


Row and plant marking on the large sheets are continuous

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Industry is dependent upon existing fields for new planting material



Mature plants offer 3 sources of plant material for perpetuation of the industry



When procuring slips some selection is necessary in order to upgrade the quality of the fruit

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Workers are placing previously cut tops on a conveyer belt for loading into a truck



Workers selecting slips for another planting



Planting material is piled on top of the parent plant so that it may be picked up easily

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A large special truck just ahead of the conveyer is equipped with a movable front end enclosure



Equipment being used to place seed material in the new planting area



Additional "seeds" are tossed out by hand to make up for any possible shortage

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The paper is punctured with the planting knife and the plant is pushed into the ground



The plants usually will root in two or three weeks

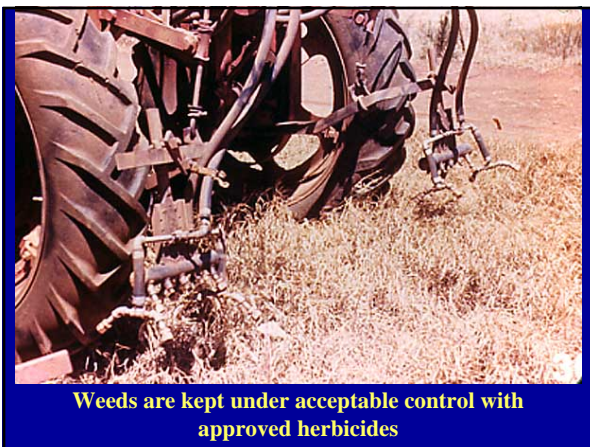


Surplus plants are placed in the drive rows and picked up by the conveyer on this truck

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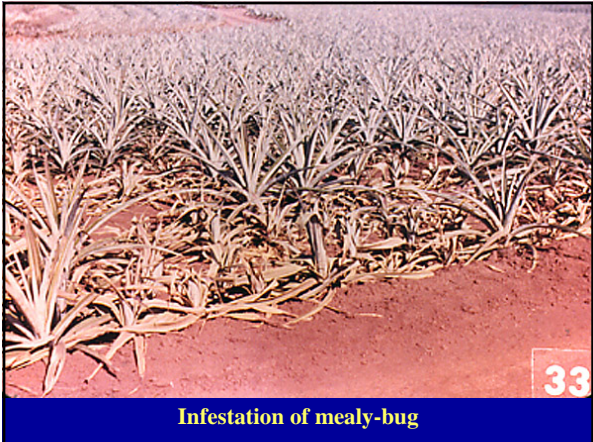




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Single plant suffering from mealy-bug wilt



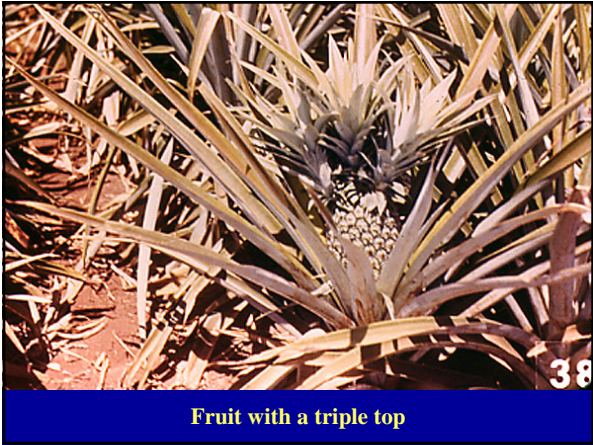
100 foot sprinkler



Small pineapple flowers on a young fruit

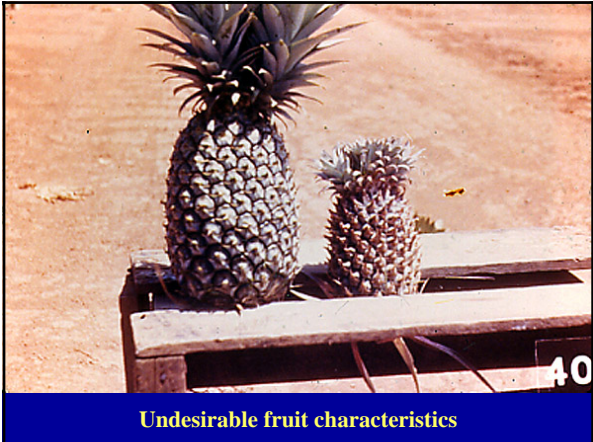
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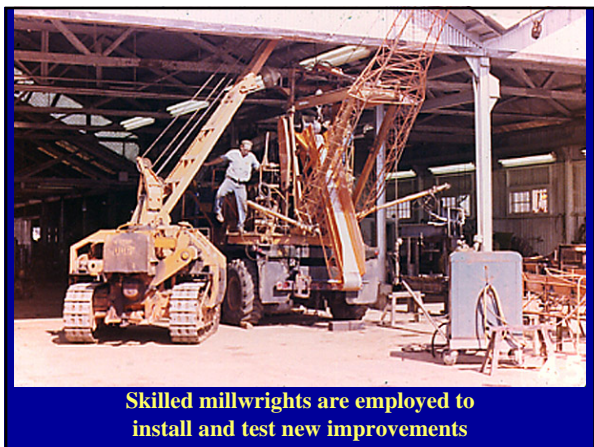




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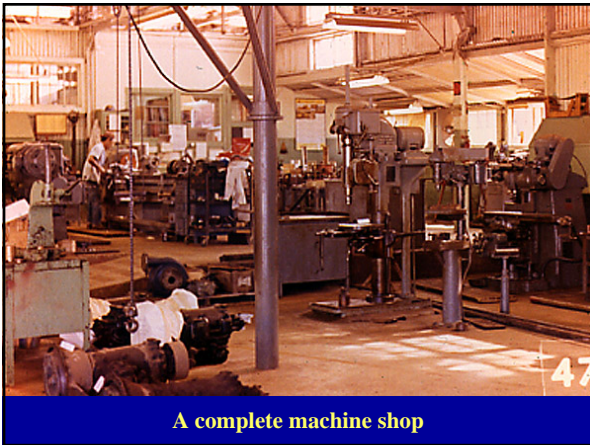






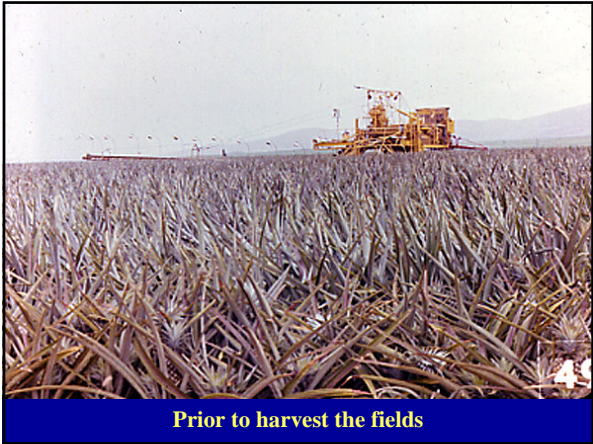
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A barge is loaded with the day's harvest and will travel at night and arrive at the cannery early the next morning
