


Tropical Horticulture: Lecture 33

Lecture 33
Avocado: *Persea americana*, Lauraceae



Name comes from Spanish *aguacata* derived from the Aztec *ahuacatl*
 A high oil fruit, protein also high for fruit crop.

Myrtle family (Lauraceae)
 Aromatic woody plants
 40 genera, 1000 species

<i>Cinnamomium zeylandicum</i>	Cinnamon
<i>Cinnamomium camphora</i>	Camphor tree
<i>Laurus nobilis</i>	Laurel or bay tree
<i>Persea americana</i>	Avocado
<i>Sassafras</i> spp.	Sassafras
<i>Umbellularia californica</i>	Oregon myrtle

Avocado Production (2001)

Continent	1000 tonnes	Chief countries
World	2,553	
Africa	213	S. Africa (81), Cameroon (50), Congo (27)
North America	1,373	Mexico (903), USA (205), Dominican Republic (111)
South America	524	Colombia (133), Chile (120), Peru (90)
Asia	329	Indonesia (130), Israel (86), China (75)
Europe	74	Spain (60), Portugal (13), Greece (1)
Oceania	39	Australia (24), New Zealand (13), Samoa (2)

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Three Horticultural Races
Mexican, Guatemalan, West Indian
Mexican
Native to highlands of Mexico, Andes to Chile, 2400 to 2800 m
Fruits ripen 6–8 months (rapid development)
Leaves are “anise” scented
Fruits are small
Trees found in higher elevations, hardy
Up to 30% oil

Guatemalan Race
Native to highlands of Central America to Ecuador and Mexico, 800 to 2400 m
Large fruit, rough skin,
Fruits mature 9–14 months, winter cultivar
Important commercial race; seeds are small, tight in cavity
Trees cold resistant
Hybrids of Guatemalan race most useful commercially
7.5–18% oil

West Indian Race
Native to lowlands of Central and South America, only introduced into West Indies
Quite sensitive to cold
Fruit size variable, skin thin and smooth
Early maturing, 6–9 months (summer variety)
Seeds loose, can shake in fruit
Cotyledons rough
5–7% oil

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Character	West Indian	Guatemalan	Mexican
Origin	Tropical lowlands	Tropical highlands	Tropical highlands
Foliage	No odor	No odor	Anise-scented
Blooming season	Feb.-March	March-April	Jan.-Feb.
Maturity season	May-Sept.	Sept.-Jan.	June-Oct.
Development period	5-8 months	10-15 months	6-8 months
Seeds	Large	Small	Relatively large
Fruit size	1-5 lbs	0.5-5 lbs	Not over 1 lb
Skin texture	Leathery-smooth	Woody-rough	Papery-smooth
Fruit oil content	Low	Med. to high	Med. to high
Cold hardiness			
Young trees	28-30°F	26-28°F	24-26°F
Mature trees	28-30°F	21-25°F	18-25°F

Flowering

Enormous flower production
1000 per fruit
5000 per 'Fuerte' fruit

Flowers very small

Perfect (12 stamens, 9 functional, each having 4 pollen chambers)

Single pistil, 1 carpel = 1 seed

Fruit considered a single seeded berry.

Some fruits development without embryo (very small fruit)

Fruits are high oil and relatively high protein

One of few fruits to enlarge by cell division rather than expansion.



Avocado in Bloom

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Important Commercial Cultivars

'Fuerte'
Considered hybrid between Mexican × Guatemalan
Dark green, somewhat pyriform, attractive, high oil
Popular cultivar in California
Some call it a new race.

'Hass'
Guatemalan type
Black skin, round, very good flavor, high oil
Gaining in popularity in California

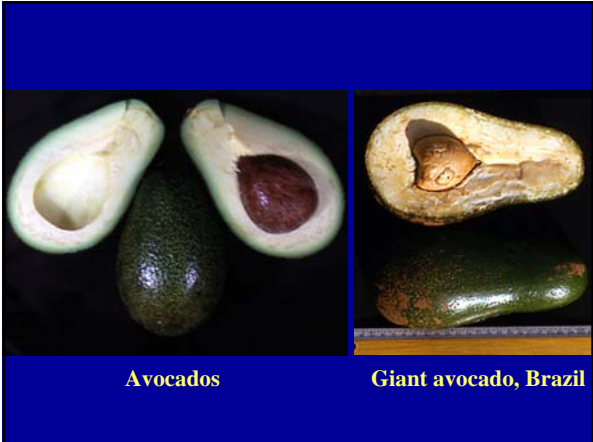


Avocado and Citrus in Java, Indonesia



Avocado varieties, Israel

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Fruit Maturation

Sugar content is low 1.5 to 3.4% before maturity

At maturity carbohydrates declines to 0.25 to 1.8% as oil content increases

Oil content in California higher than Florida

Fuerte: 25% California
13-17% Florida

In California, standards are based on oil, but flavor not correlated with oil.

Florida avocados generally have much lower oil than California types.

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Pollination and Fruit Set

Protogynous dichogamy with synchronyous daily complementarity

Protogynous = pistil receptive first

Dichogamy = differential maturation of stamens and stigma

Two Classes of Cultivars

Class A

New flowers open daily, sometimes in the morning, exact time depends on cultivar

They do not shed pollen in the morning

Pistil is mature, and receptive so flower functions as female

Closes at noon and stays closed until the afternoon of following day

Reopens and acts as male

TODAY AM	female
TOMORROW PM	male

Class B

Flowers open first time in the afternoon but pollen does not shed and close in the evening

In the afternoon, pistil is receptive, thus acts as female

Reopen the following day in the morning and sheds pollen, acts as male

TODAY PM	female
TOMORROW AM	male

Thus to get good pollination and fruit set avocado grower has to have more than one cultivar of which some are Type A and some are Type B.

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		TYPE A	TYPE B
DAY 1	Morning	Open female	Closed
	Afternoon	Closed	Open female
DAY 2	Morning	Closed	Open male
	Afternoon	Open male	Closed

Propagation
Most avocados grafted
Ungrafted, 7-10 years to bear
Grafted 1-3 years to bear
In California used Mexican or Guatemalan root stocks
In Florida use Waldin stocks, sturdier and faster growing

Planting Distance
20-35 ft spacing within rows,
35-40 ft between rows.



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The planter is removing the building-paper pot which has surrounded the plant in the nursery



Soil is filled around the set tree



After the hole is filled with soil the planter will tamp the soil with a wood stick or his feet to compact the soil around the ball of the tree

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Soil is added around the tree from the surrounding area in order to have sufficient soil to build a water-holding basin



After the basin is completed a mulch is placed in the basin and a paper protector is placed around the tree



A newly planted avocado orchard on a terraced hill location

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A natural cover crop of weeds and grasses.



Non-cultivation is the most popular method of soil management. Herbicides or oil are used to prevent weeds from becoming established.



A grove where furrow irrigation and non-cultivation is practiced by the grower

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One commercial cultivar is 'Zutano'.
Shown here is the typical upright growth.
The fruit is green and of medium quality, ripening late in the fall.
Because 'Zutano' is more tolerant of frost it is recommended for locations where frost may be a problem.

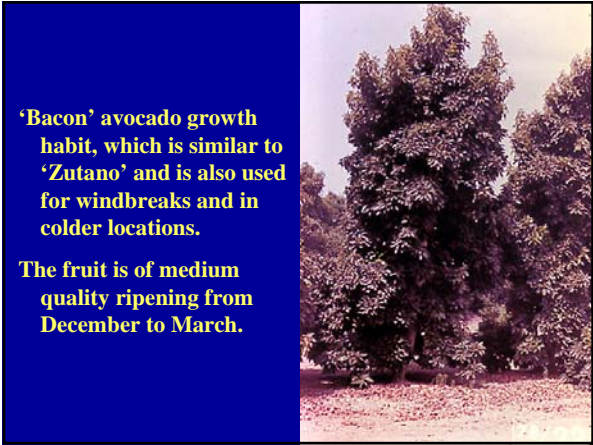


'Zutano' fruit, which is rather large and has a relatively large seed.
The fruit is considered of medium quality and is picked from October to February.



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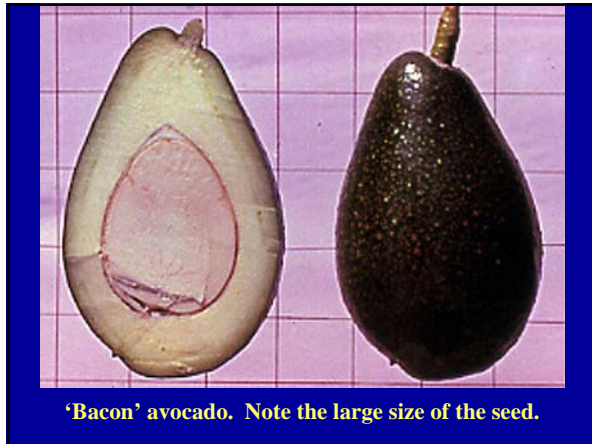


'Bacon' avocado growth habit, which is similar to 'Zutano' and is also used for windbreaks and in colder locations. The fruit is of medium quality ripening from December to March.





Cluster of 'Bacon' fruits showing their smooth green skin

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Growth habit of 'Hass' avocado, which is a medium spreading tree. It is second in commercial production area. It produces a dark, rough skinned fruit of high quality. 'Hass' is less resistant to frost damage than 'Zutano' or 'Bacon'. It should be planted in a warm location only.






A cluster of 'Hass' avocados. Note the rough exterior texture. 'Hass' turns dark at maturity and is picked from April to October. It has a long storage life on the tree.

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'Hass' fruit.
The yellow flesh and the dark green band immediately under the skin are very desirable traits.
Note also the small seed.

'Rincon' avocado.
This tree is small, low, and spreading.
It is no longer recommended because of the poor shipping qualities of the fruit and its tendency to produce poorly.
Growers with this variety may increase their production by top-working their trees to a more desirable cultivar.

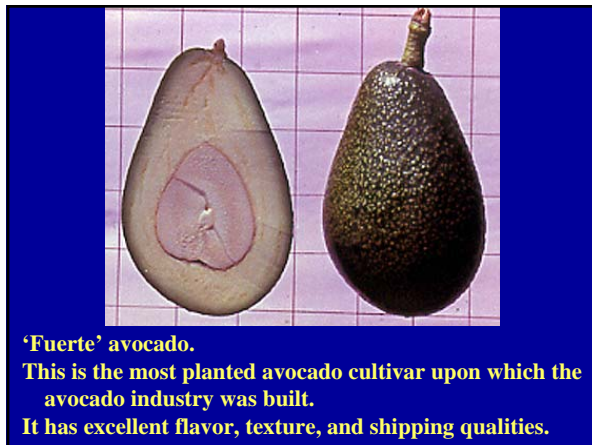


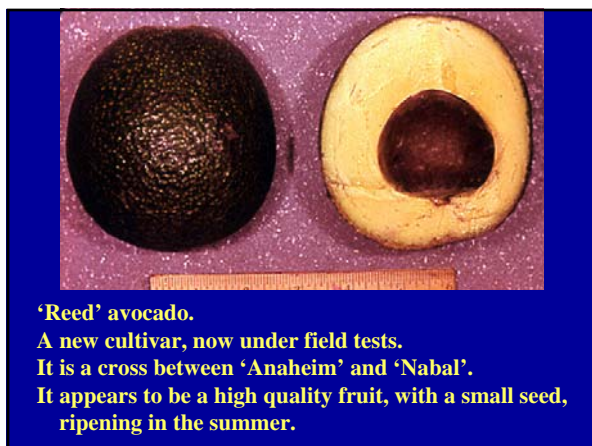


'Rincon' fruit.
Note the large seed and the dark areas in the flesh which are "strings."
This is a medium quality fruit.
It is harvested from March to May.

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An orchard of 'Fuerte' trees that are being top-worked to another cultivar which will produce more fruit because of the location of the property. The trees are dehorned, as shown, in the fall and then are top-worked with the new variety in February or March.



A newly top-worked tree showing the two scions and the stakes to support them. Paper protects the stump from sunburn and prevents water from entering the stump.

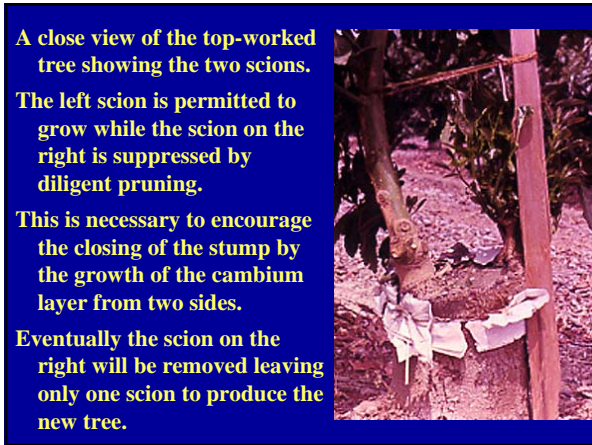


An orchard that has been top-worked to 'Hass'. The larger trees were top-worked a year earlier and show the vigorous growth that takes place within a short time because of a large root area available to nourish the small scions.

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A closer view of one of the recently top-worked trees showing how paper is placed to protect the trunk.

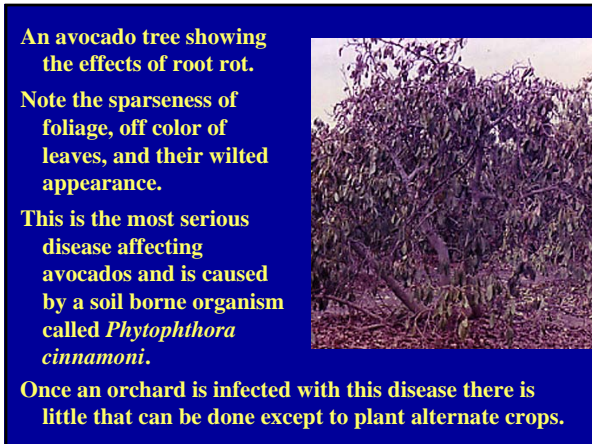


A close view of the top-worked tree showing the two scions.

The left scion is permitted to grow while the scion on the right is suppressed by diligent pruning.

This is necessary to encourage the closing of the stump by the growth of the cambium layer from two sides.

Eventually the scion on the right will be removed leaving only one scion to produce the new tree.



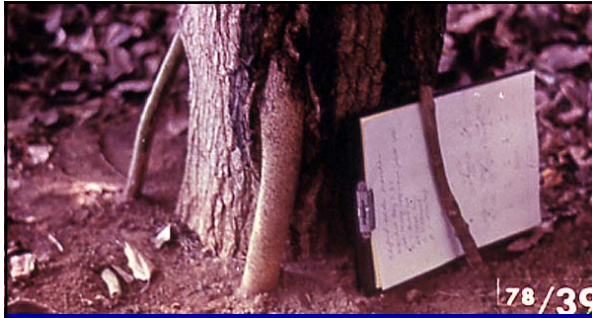
An avocado tree showing the effects of root rot.

Note the sparseness of foliage, off color of leaves, and their wilted appearance.

This is the most serious disease affecting avocados and is caused by a soil borne organism called *Phytophthora cinnamoni*.

Once an orchard is infected with this disease there is little that can be done except to plant alternate crops.

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**An avocado tree that has root rot.
It is being inarched with disease tolerant seedling trees
that have been planted around the tree in an attempt to
develop a new root system that will tolerate the fungus.**



**Zinc deficiency in an avocado tree as indicated by
dieback of older growth, off color of new growth,
and rosetting of new leaves.
Easily corrected by a zinc spray.**



**Zinc deficiency as compared to a normal twig.
Note that leaves are smaller, narrower, yellower, and
rosetted.
Note also that fruit is round instead of elongated.**

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Zinc deficient 'Hass' fruit on each side as compared with the normal fruit in the center



Iron deficiency in a young tree as indicated by the yellow appearance of the leaves.



Iron deficiency as compared to the normal leaf. Note that the blade area between the veins is yellow and the veins are green.

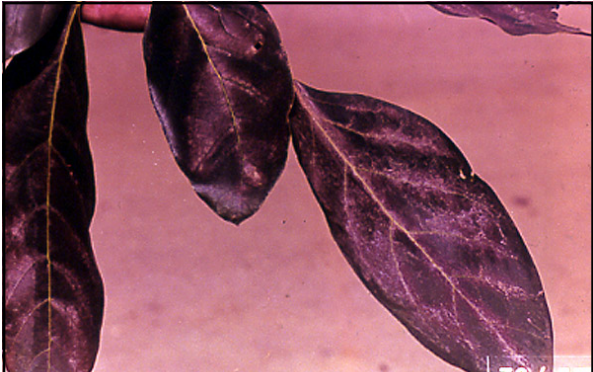
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Tip burn caused by high salt in the soil or water. Irrigation practices can alleviate the problem

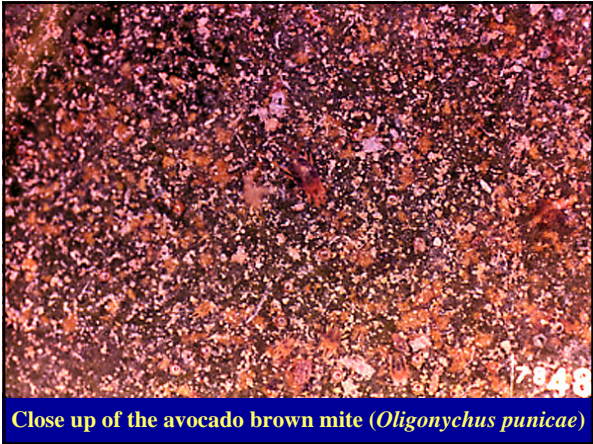


Damage to avocados due to the instars of the omnivorous looper (*Sabulodes caberata*)



Avocado brown mite which collects along the ribs of the leaf causing the brown appearance of the leaves

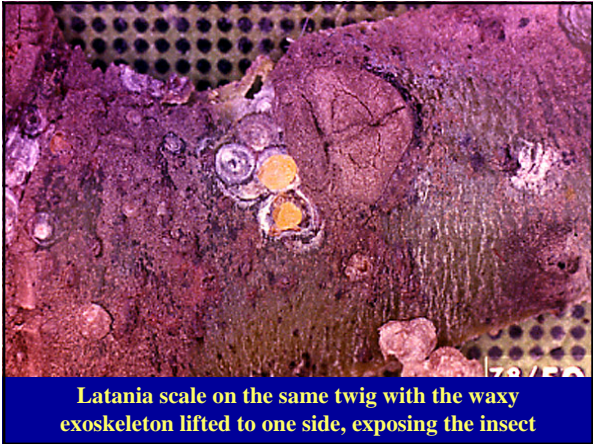
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Close up of the avocado brown mite (*Oligonychus punicae*)



Latania scale on the twig of avocado. This is not an important pest and control is not recommended.



Latania scale on the same twig with the waxy exoskeleton lifted to one side, exposing the insect

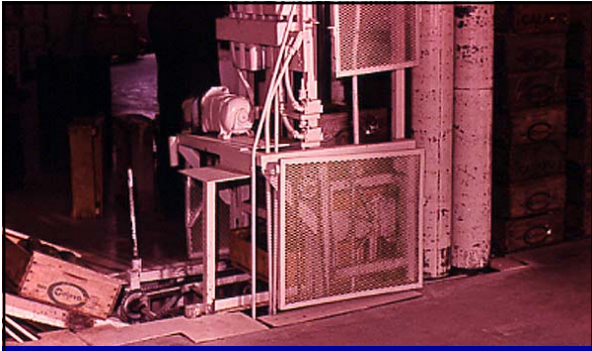
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Spray rig with a hand gun. One type of equipment used on many agricultural crops for pest control work.

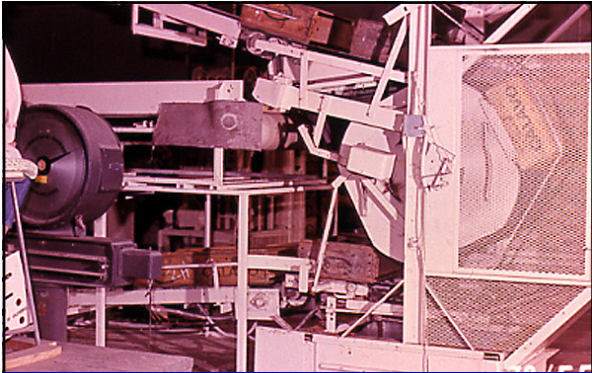


The Selma Tree Farmer is a mechanical aid for pruning or harvesting of fruit

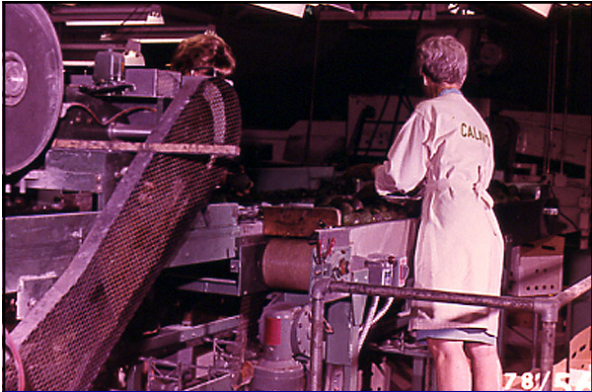


Avocado fruit arrives at the packing house in field boxes stacked one on top of another. This machine unstacks the boxes and feeds them into a dumping machine.

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Automatic weighing machine where three boxes of fruit are weighed at one time

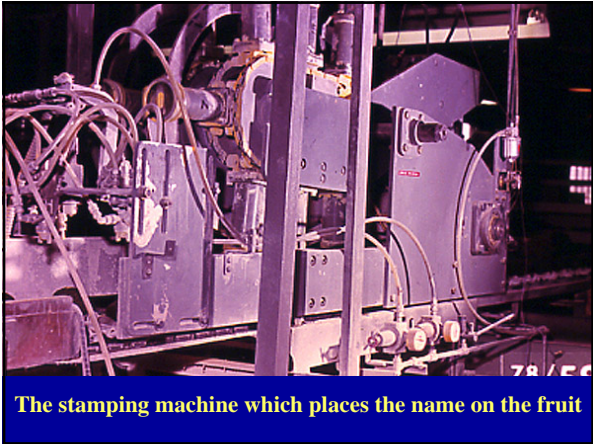


Fruit is inspected for defects



After the fruit is graded it is placed in cups ahead of the stamping machine which places the packing house trade name on the fruit

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Layers of fruit are placed on top of styrofoam liners and when full are pushed onto the conveyer belt shown to the right of the tub



Each carton passes this weighing station where the total weight is adjusted to a uniform total weight by either adding or taking away of fruit



Boxes pass into this machine which automatically applies glue and folds down the flaps holding them for a sufficient time for the glue to set

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Boxes of fruit are placed on pallets for easy moving about the packing house. They are either shipped to market or held in storage.