Chapter 2 - Avocado Botany and Commercial Cultivars Grown in California

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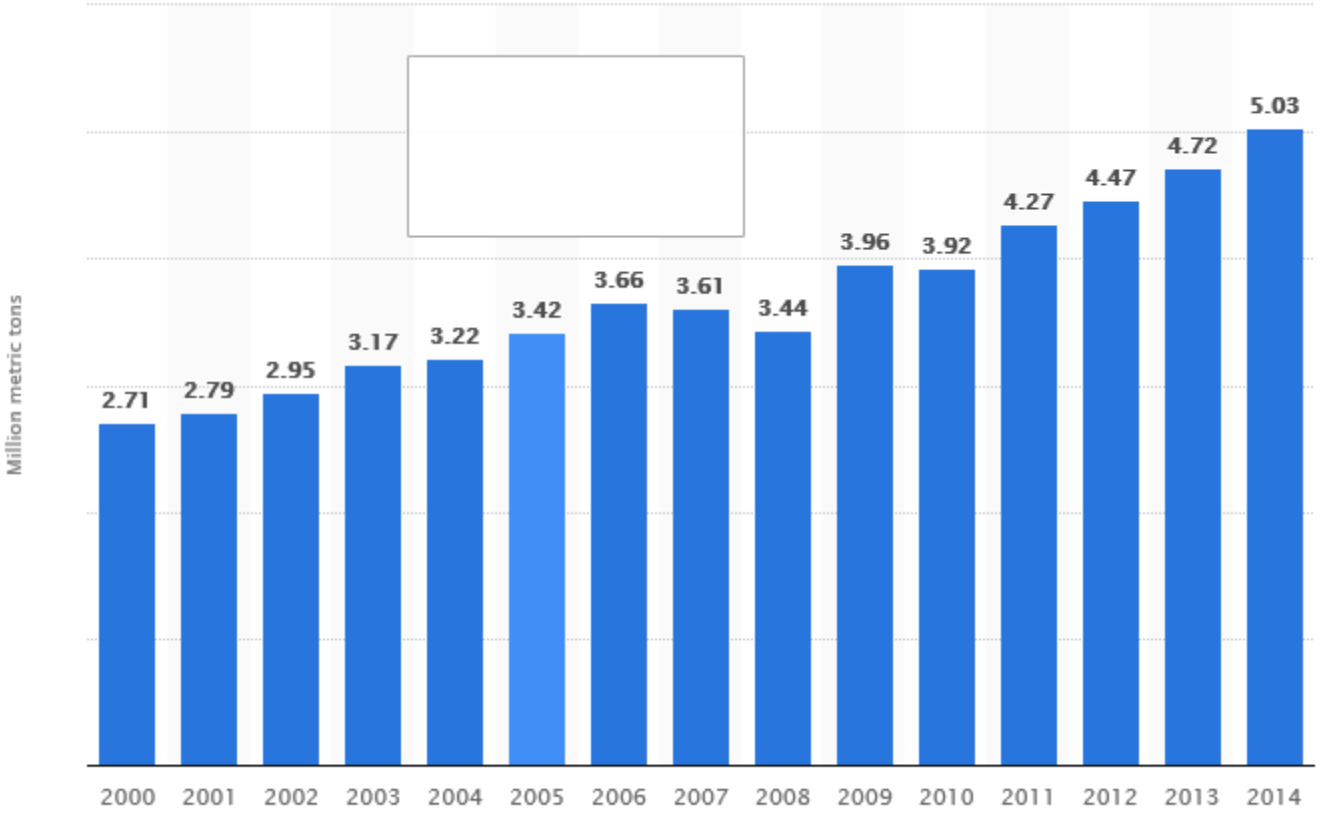
Where do Avocados Come From?

- Southern Mexico and Central America is the area of origin for avocado; wild avocados can still be found in rainforests.
- Mexico is the leading producer of avocado by far, followed by Chile and Indonesia. USA was fourth in production (2009), seventh in production (2014)
  - This changes from year to year

Production (2014) Metic Tons

- Mexico 1,520,695
- Dom Rep 428,301
- Peru 349,317
- Indonesia 307,326
- Columbia 288,739
- Kenya 218,692
- USA 179,124
- Rwanda 161,519
- Chile 160,000
- Brazil 156,699

Worldwide Increase in Avocado Production



Hass Avocados
California and Imports
millions of pounds

2014

Calif.	Mexico	Chile	Dom. Rep.	New Zealand	Peru
282	1,331	89	2.7	6.6	144

2015

Calif.	Mexico	Chile	Dom. Rep.	New Zealand	Peru
262	1,773	21	19	0.27	106

- In California, for many years, San Diego County grew almost half of all the avocados produced in the US, however this is declining due to high water prices.
- The rest of the production is from Ventura, Santa Barbara, Riverside and San Luis Obispo counties.

2014 California Avocado Acreage Inventory Summary by County

County	Producing Acres	Topped/Stumped Acres	New/Young Acres	Total Planted Acres	CAC Bearing Acres (Pro+Top)
San Diego	17,406	1,033	441	18,880	18,439
Riverside	5,235	261	481	5,977	5,496
Ventura	16,437	488	1,281	18,206	16,925
Santa Barbara	4,651	188	440	5,279	4,839
San Luis Obispo	3,567	254	187	4,008	3,821
Total 5 Counties	**47,296**	**2,224**	**2,830**	**52,350**	**49,520**
Total Minor Counties*				1,958	1,958
Grand Total				**54,308**	**51,478**

* Orange, Los Angeles, San Bernardino, San Joaquin Valley, Monterey

San Diego County now has 35% of the acreage

Varietal Production 2001-2002

Cultivar	Bearing Acreage	Estimated yield (lbs/A) in 2001-2002	Estimated yield in California (million lbs) in 2001-2002
Hass	51, 575	7,044	363.3
Fuerte	1,452	4,125	6.0
Bacon	1,961	6,645	13.0
Zutano	706	3,144	2.2
Pinkerton	1,035	4,715	4.9
Reed	430	7,163	3.1
Gwen	260	5,633	1.5
Lamb Hass	420	5,143	2.2
Other	388	3,058	1.2
Total	**58,227**	**6,825**	**397.4**

Varietal Production 2011-2012

Cultivar	Acreage (includes 7,800 acres of topped/stumped groves)	Yield in lbs/A in 2011-2012	Yield in California (million lbs) in 2011-2012
Hass	56,548	7,924	448.1
Lamb Hass	1,964	5,295	10.4
Other	1,117	3,312	3.7
Total	**59,629**	**7,753**	**462.3**

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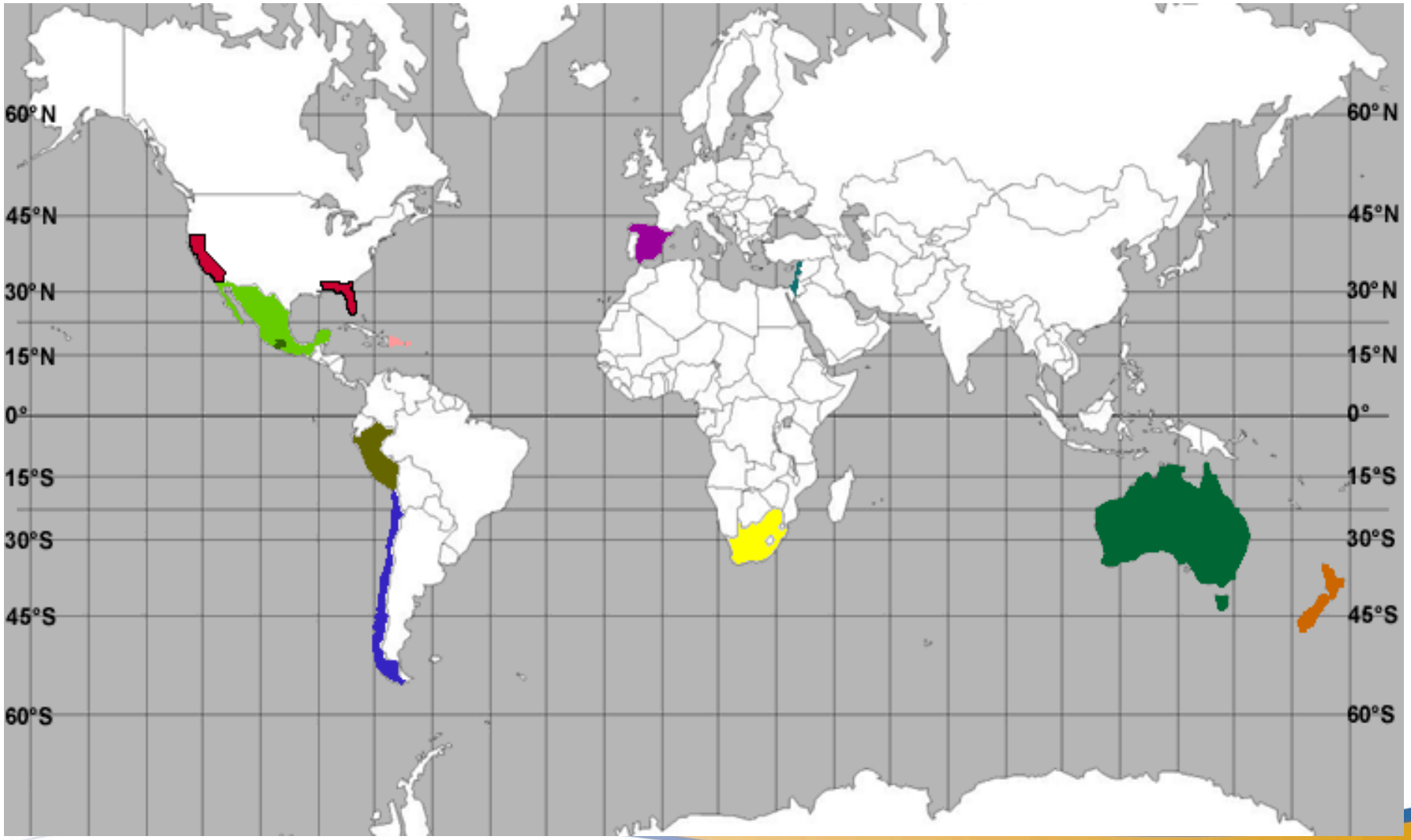
CALIFORNIA AVOCADO COMMISSION
POUNDS & DOLLARS BY VARIETY

November 2016 Through September 2017

Month	Hass Pounds	Lamb Pounds	Others Pounds	Total Pounds	Hass Dollars	Lamb Dollars	Others Dollars	Total Dollars	Avg $/Lb
Nov 2016	0	0	130,819	130,819	0	0	171,515	171,515	1.311
Dec 2016	622,877	0	73,219	696,096	533,191	0	53,191	586,382	0.842
Jan 2017	2,858,444	0	222,857	3,081,301	3,133,764	0	74,490	3,208,254	1.041
1st QTR	**3,481,321**	**0**	**426,895**	**3,908,216**	**3,666,955**	**0**	**299,196**	**3,966,151**	**1.015**
Feb 2017	5,313,315	0	99,783	5,413,098	7,105,014	0	53,585	7,158,599	1.322
Mar 2017	24,120,745	0	168,780	24,289,525	36,985,987	0	70,781	37,056,768	1.526
Apr 2017	41,835,105	194	226,375	42,061,674	66,489,074	63	333,239	66,822,376	1.589
2nd QTR	**71,269,165**	**194**	**494,938**	**71,764,297**	**110,580,075**	**63**	**457,605**	**111,037,743**	**1.547**
1st Half	**74,750,486**	**194**	**921,833**	**75,672,513**	**114,247,030**	**63**	**756,801**	**115,003,894**	**1.520**
May 2017	52,152,841	20,458	89,130	52,262,429	85,701,667	24,173	142,615	85,868,455	1.643
Jun 2017	39,299,784	537,923	182,413	40,020,120	63,604,592	716,147	210,010	64,530,749	1.612
Jul 2017	31,079,497	3,862,117	70,959	35,012,573	49,950,205	5,202,000	77,926	55,230,131	1.577
3rd QTR	**122,532,122**	**4,420,498**	**342,502**	**127,295,122**	**199,256,464**	**5,942,320**	**430,551**	**205,629,335**	**1.615**
Aug 2017	9,492,351	2,574,175	83,363	12,149,889	18,961,562	4,468,228	118,977	23,548,767	1.938
Sep 2017	550,216	194,066	49,654	793,936	1,216,803	358,165	68,018	1,642,986	2.069
4th QTR	**10,042,567**	**2,768,241**	**133,017**	**12,943,825**	**20,178,365**	**4,826,393**	**186,995**	**25,191,753**	**1.946**
2nd Half	**132,574,689**	**7,188,739**	**475,519**	**140,238,947**	**219,434,829**	**10,768,713**	**617,546**	**230,821,088**	**1.646**
Total	**207,325,175**	**7,188,933**	**1,397,352**	**215,911,460**	**333,681,859**	**10,768,776**	**1,374,347**	**345,824,982**	**1.602**
Grand Total								**345,824,982**	**1.602**
Y-T-D (%)	96.02%	3.33%	.65%	100.00%	96.49%	3.11%	.40%	100.00%	
Y-T-D AVG $/LB					1.609	1.498	0.984	1.602	

World Avocado Production



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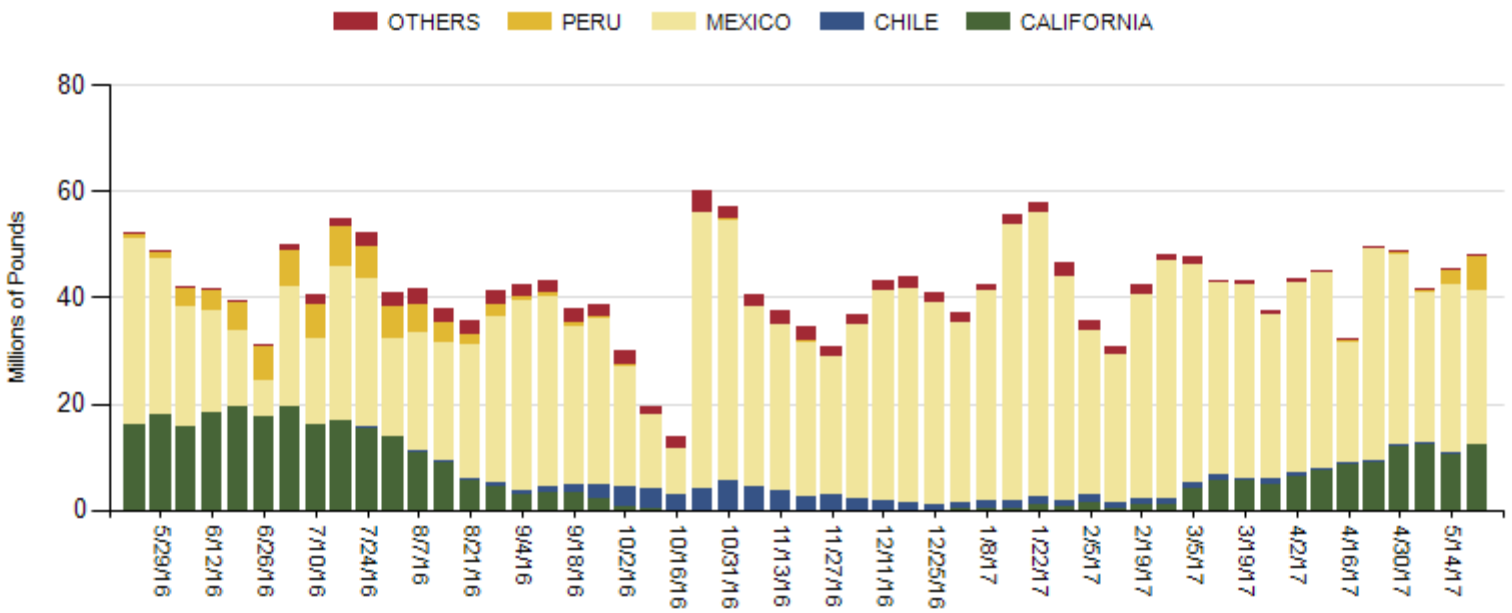
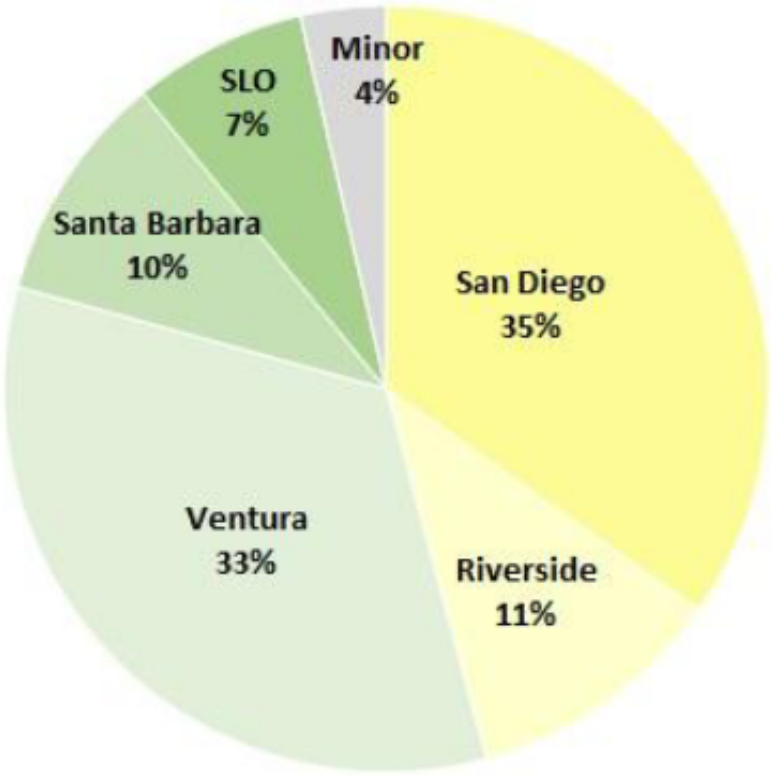


2014 Planted Avocado Acres by County



2014 Varietal Distribution	
Variety	Acres
Hass	49,023
Lamb	1,612
Other	843
Total	**51,478**

Botany

- Avocado belongs to the **Lauraceae** family
- In this family, only two significant genera for agriculture
- Genus: ***Persea*** (50 other genera in Lauraceae, mostly tropical or subtropical) (a few temperate genera including *Sassafras* from eastern U.S.)

- Genus: ***Cinnamomum*** includes cinnamon and camphor species

- **Family: Lauraceae**
  - **Genus: *Persea***
    - ***Subspecies: Persea***
      - ***Includes Persea americana (commercial avocado}***
      - ***And P. shiedeana (parent of a resistant rootstock G755)***
    - ***Subspecies: Eriodaphne***
      - ***A group of species resistant to avocado root rot, but not graft compatible with commercial avocado cultivars***

Avocado Races (botanical varieties)

- ***Persea americana*** is the genus and species of the commercial avocado
- Others such as ***Persea borbonia*** are immune to root rot fungus, but they are not graft compatible with commercial varieties

1. **Mexican race** (thin skinned)
2. **Guatemalan race** (thick skinned)
3. **West Indian race** (very tropical)

Characteristics of Botanical Races

- **Mexican:** earlier harvest, anise smell to leaves, thin skin, more cold tolerant, seed size is large, no root rot tolerance, very sensitive to salinity
- **Guatemalan:** later harvest, no anise smell to leaves, thick skin, intermediate cold tolerance, seed size small, no root rot tolerance, salt tolerance intermediate

Characteristics of Botanical Races

West Indian: earliest harvest, no anise smell to leaves, medium skin thickness, least cold tolerant, seed size variable, poor root rot tolerance, **most salt tolerance, fruit texture is 'watery'**

- **More tolerant to tropical conditions.**
- **Short harvest seasons.** Florida has selected early, mid and late season cultivars to extend their season

The California Varieties

- **Hass** and **Fuerte** (and many others) are **Mexican-Guatemalan hybrids**
  - The Mexican genes impart earlier harvest
  - The Guatemalan genes impart a thicker peel, allowing successful shipping of fruit
  - An interest in West Indian as a rootstock because it has better salt tolerance

Freezing

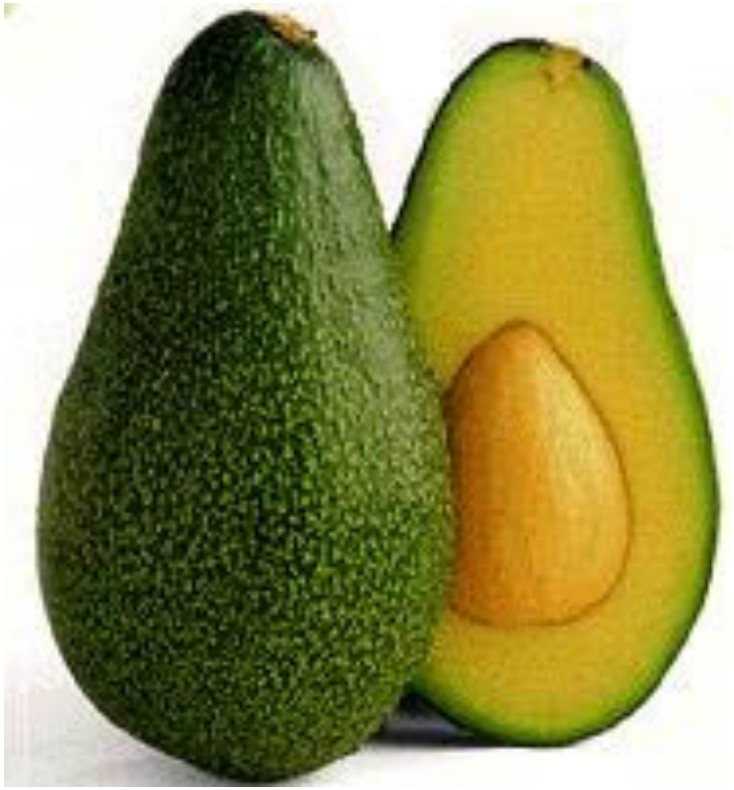
- Hass (85% Guatemalan, 15% Mexican) fruit will freeze if held at 29F for four hours
- Fuerte (50-50 Guatemalan/Mexican) fruit will freeze if held at 26-27F for four hours
- Bacon (mostly Mexican) fruit will freeze if held at 25F for four hours

Hass

Harvest Season for Hass

- Jan-Aug (San Diego)
- As late as June-Oct in Santa Barbara and San Luis Obispo Counties
- Almost year round in Calif. (but not quite)
- Often size picked for 7.5 to 9.0 ounce fruit (size 48) to get the best prices

Fuerte and Pinkerton



Reed

Lamb Hass

Zutano

Bacon

Avocado Cultivars

- Problems with Hass – **Why we have a breeding project**

  Cold tender

  Productivity is inferior

  Tree production alternates

  Grove production varies from year to year (1,813 lbs. to 20,995 lbs. in one grove over a five year period)

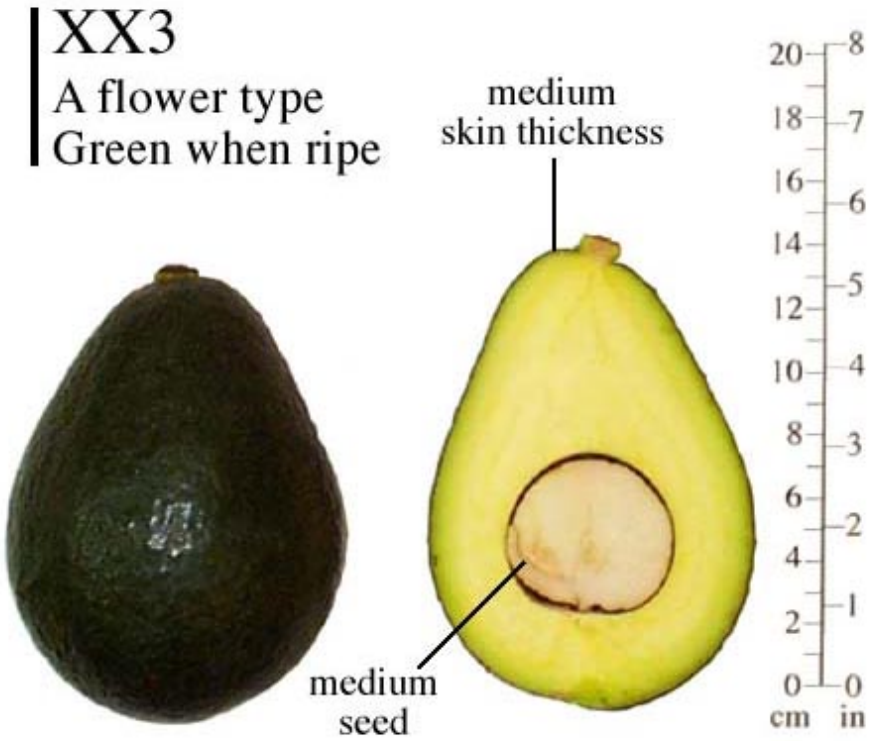
  Industry production varies from year to year

  Black color not universally accepted in the avocado (1950's)

  The tree is too large

  Hass is more subject to stresses (drought, salinity, insect damage)

Holiday (XX3)



- **HOLIDAY**
- **Parentage:** Guatemalan
- **Peels:** Yes
- **Seed Size:** Medium
- **Skin Texture:** Medium
- **Blossom Type:** A
- **Fruit Shape:** Obovate
- **Skin Color Unripe:** Green
- **Skin Color Ripe:** Green
- **Skin Thickness:** Medium
- **Average Fruit Weight oz:** 18-24
- **%Ratio Skin/Seed/Flesh:** 16:13:71
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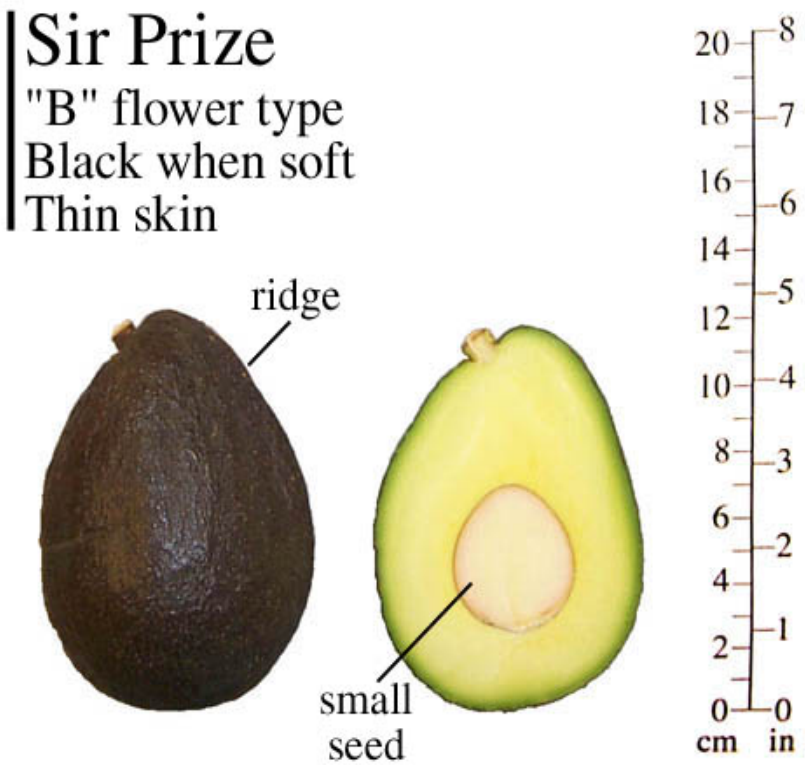
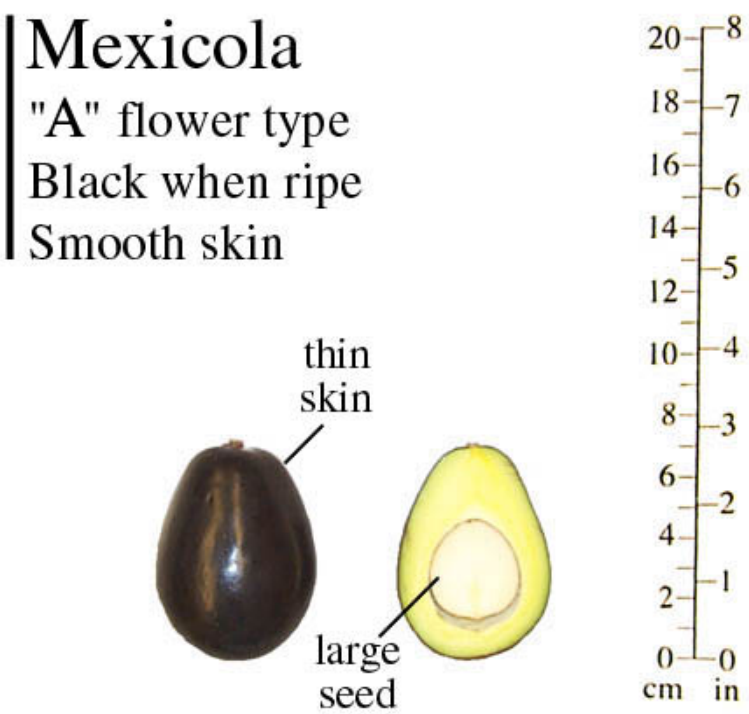
Sir Prize



- Sir Prize
- **Parentage:** Mexican hybrid
  Peels: Yes
  Seed Size: Small
  Skin Texture: Medium
  Blossom Type: B
  Fruit Shape: Obovate
  Skin Color Unripe: Green
  Skin Color Ripe: Black
  Skin Thickness: Thin
  Average Fruit Weight oz: 10-20
  %Ratio Seed/Skin/Flesh: 9:8:83

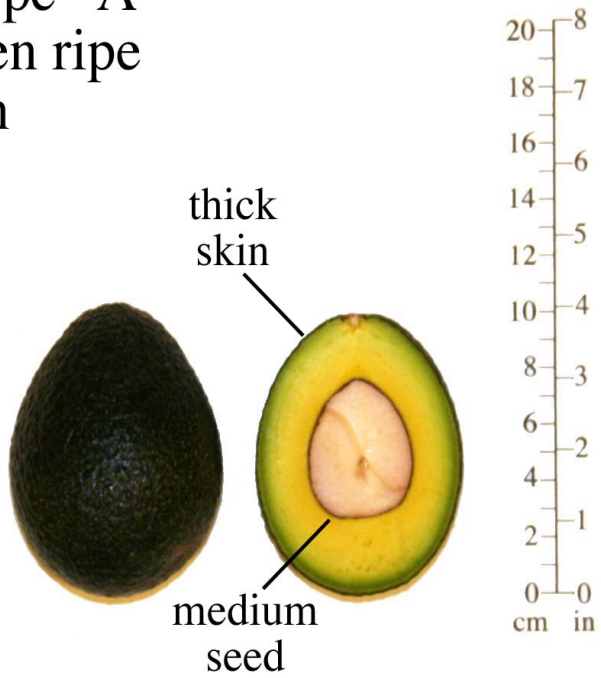
Mexicola



- **Parentage:** Mexican
  Peels: No
  Seed Size: Large
  Skin Texture: Smooth
  Blossom Type: A
  Fruit Shape: Obovate
  Skin Color Unripe: Black
  Skin Color Ripe: Black
  Skin Thickness: Thin
  Average Fruit Weight oz: 4 to 6.5
  %Ratio Seed/Skin/Flesh: 27:12:61

GEM

GEM
Flower Type "A"
Black when ripe
Thick skin



- **Parentage:** Guatemalan
  Peels: Yes
  Seed Size: Medium
  Skin Texture: Medium
  Blossom Type: A
  Fruit Shape: Ellipsoid
  Skin Color Unripe: Green to Black
  Skin Color Ripe: Black
  Skin Thickness: Thick
  Average Fruit Weight oz: 7 to 11
  %Ratio Seed/Skin/Flesh: 15:13:72

- Fruit oxidizes slower than Hass

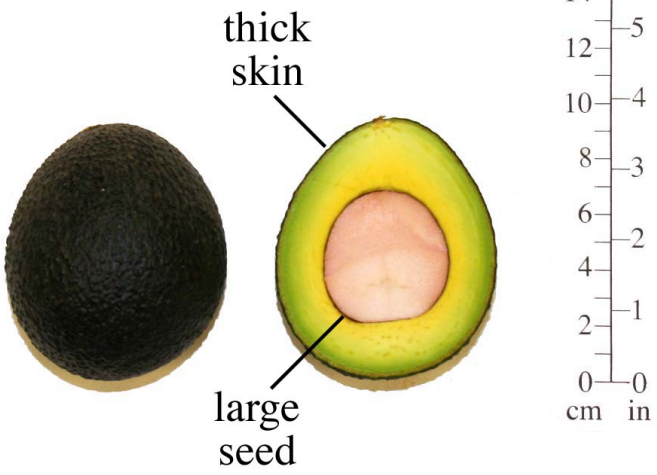
GEM on the left, Hass on the right

Central Valley

- One of the research goals is to develop a variety that does well in the Central Valley
- Dr. Mary Lu Arpaia says that GEM, and two new varieties ‘lunchbox’ and an un-named variety do well in Visalia

Harvest

Harvest
Flower Type "A"
Black when ripe
Thick skin



- **Parentage:** Guatemalan
  Peels: Yes
  Seed Size: Large
  Skin Texture: Medium
  Blossom Type: A
  Fruit Shape: High spheriod
  Skin Color Unripe: Dark Green
  Skin Color Ripe: Black
  Skin Thickness: Thick
  Average Fruit Weight oz: 7 to 10
  %Ratio Seed/Skin/Flesh: 15:14:71

- Mature late season same as Lamb Hass or Reed

West Indian race

larger, thinner skinned and more watery than Mexican-Guatemalan hybrids

“Cukes” (non-fertilized, no seed)

fairly common in the Fuerte cultivar


Unknown Seedlings
Tonnage
Choquette
SHEPARD
MACARTHUR
Rincon
Hass
Hall

Avocado Breeding Program

"It is dangerous to have an industry based on one variety"

- Dr. Mary Lu Arpaia, UC Extension Horticulturist

"Hass can be improved"

1. Tree size and structure
2. Bearing habit
3. Alternate bearing
4. Stress tolerance
5. Disease and pest tolerance
6. Productivity
7. Seasonality