SESSION FOUR

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New germplasm and global breeding programmes

New Zealand and Australia Avocado Grower's Conference'05
20-22 September 2005
Tauranga, New Zealand

AVOCADO GERMPLASM PRESERVATION AND BREEDING PROGRAM IN CALIFORNIA

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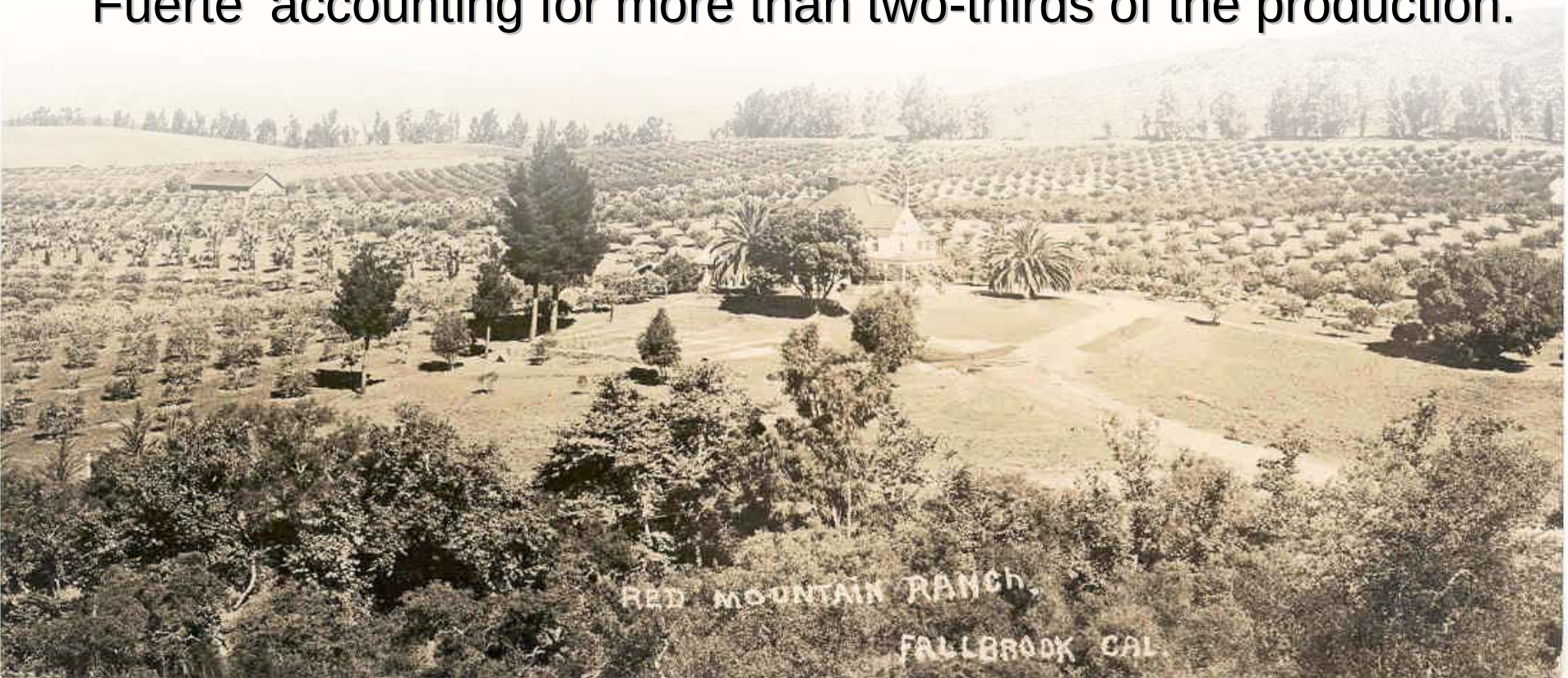
The California avocado breeding and germplasm preservation programs are run in four related modules each as separately administered projects:

1. Conventional scion breeding: selection and evaluation of improved varieties (Arpaia)
2. Screening and evaluation of new rootstocks with resistance to *Phytophthora cinnamomi* and other desirable traits (Douhan)
3. Application of molecular markers to (Clegg) avocado improvement
4. Germplasm preservation (Arpaia)

Scion Breeding: Avocados were introduced to California at the turn of the last century. Growers, enthusiasts and researchers have been hunting for improved varieties ever since.

By the 1950's around 25 different varieties of avocados were being commercially packed and shipped in California, with 'Fuerte' accounting for more than two-thirds of the production.



Even though ‘Hass’ was discovered in the early 1930’s and patented by Rudolph Hass in 1935, it was not until large-scale industry expansion occurred 40 years later (in the late 1970’s) that ‘Hass’ replaced ‘Fuerte’ as the leading California variety.

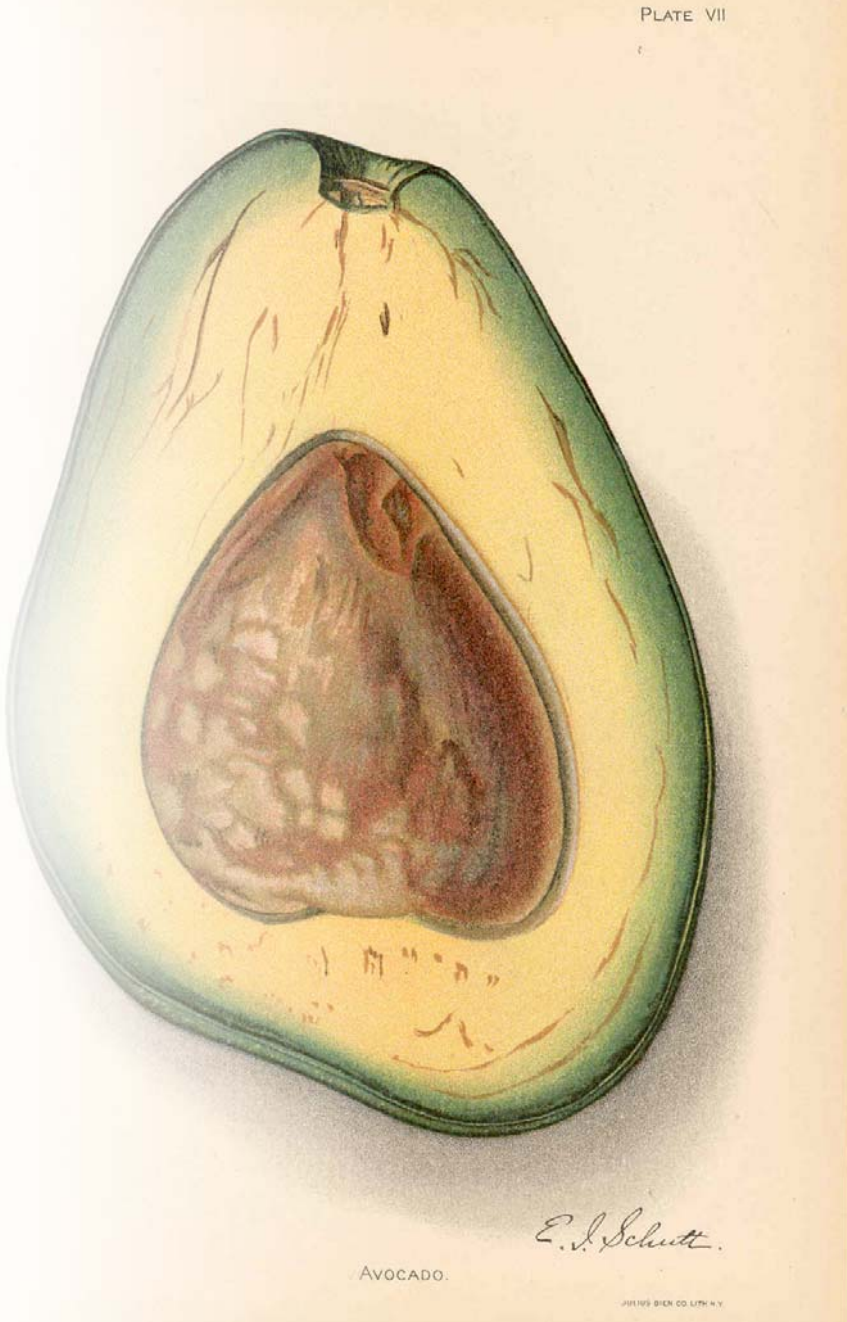
Rudolph and Elizabeth Hass

The first controlled breeding in California: 1937 by J. W. Lesley at UC Riverside, and 1939 by W.E. Lammerts at UCLA.

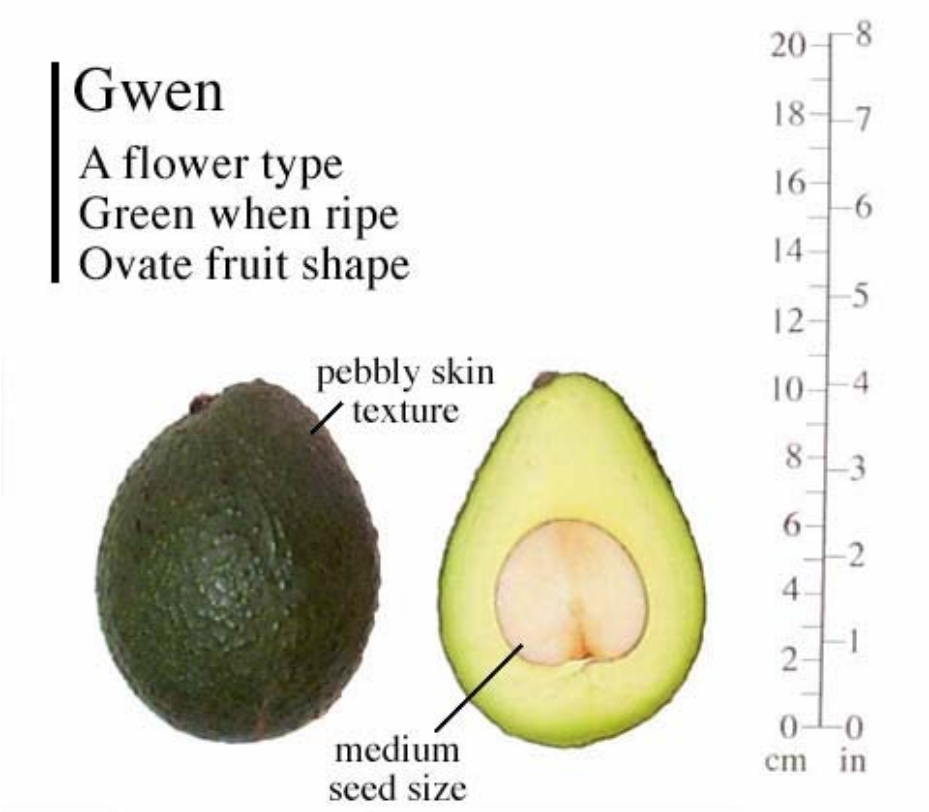
Bob Bergh took over the UC Riverside breeding program in 1956 and twenty years after planting and screening around 15000 seedlings from promising parents, the first varieties with real potential for commercial success, ‘Gwen’, ‘Whitsell’ and ‘Esther’ were released to the industry in 1982

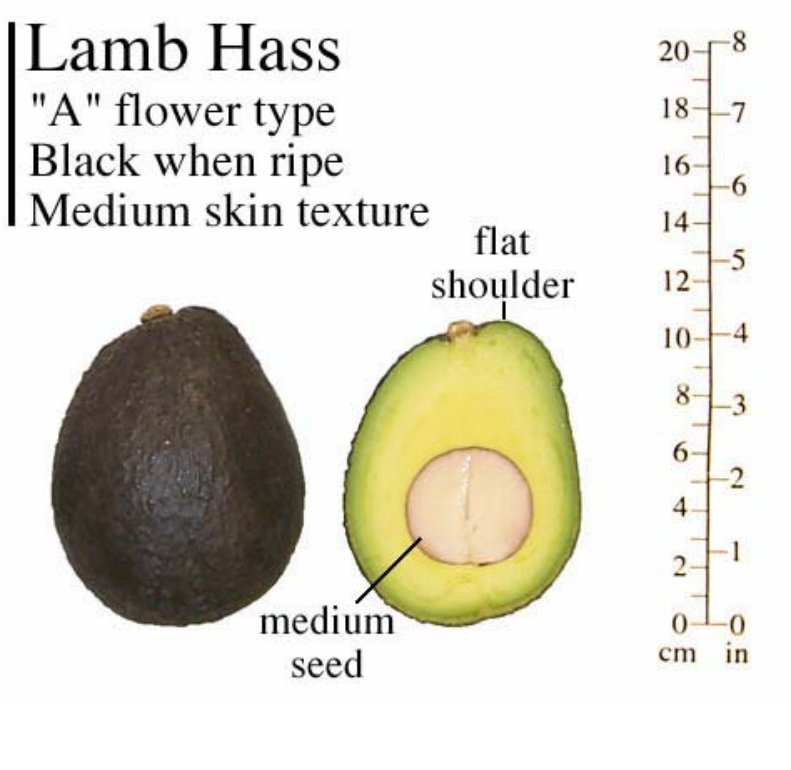
In a second wave, about 60000 seedlings, predominantly derived from ‘Gwen’, ‘Whitsell’, ‘Hass’ and ‘Pinkerton’ hybrids, were planted on private properties across the industry.

These massive plantings yielded only a handful of selections with commercial potential including the named varieties ‘Lamb Hass’, ‘Sir Prize’, ‘Harvest’, and ‘GEM’.



75000 seedlings, significant acreage, consuming millions dollars = ‘Gwen’, ‘Whitsell’, ‘Esther’,‘Lamb Hass’, ‘Sir Prize’, ‘Harvest’, and ‘GEM’.





*including man hours in care and evaluation, grower research expenditures, UC contribution, and lost revenue to grower cooperators

Today a major emphasis of the scion breeding program is to establish new seedling populations in the field for evaluation and screening.

About 1000 plants will be established in the field in 2005 to augment the approximately 1200 plants already established, and this number is expected to ramp up each year in coming seasons.

The scion breeding program will continue to do fruit evaluations of existing varieties, ‘new’ varieties, as well as recent selections.

The program is evaluating ‘Hass’-like selections introduced from other industries including Mexico and Chile.

‘Carmen’ -- Mexico

<u>Rootstock Breeding</u>: Has a more recent history than scion breeding. Search for improved rootstocks began in earnest after the discovery of avocado root rot (*Phytophthora cinnamomi* Rands).

Not until commercialization of clonal rootstock propagation methods (late 1970's), did it became possible to introduce improved rootstocks to the industry.

Clonal avocado rootstock production was first introduced commercially by W. H. Brokaw in 1977 with the first planting of 'Hass', 'Pinkerton' and 'Bacon' on clonal 'Duke 7' rootstock.

W. H. 'Hank' Brokaw

Today, the majority of new generation avocado trees planted in California are on clonal rootstocks. The California grower has an increasing selection of rootstocks to choose from and we are beginning to better understand the environmental adaptation and influence of the rootstock on the scion's productivity and growth habits.

ACW Nursery

Fruit yield of ‘Hass’ on various rootstocks in Escondido, California (June 2005)

Rootstock	Fruit weight per tree (kg)	Ind fruit weight (kg)
Merensky II (Dusa)	38.61a	0.24 a
Uzi	31.78 ab	0.24 a
Merensky I (Latas)	30.73 abc	0.23 a
Steddom	28.87 abcd	0.25 a
Duke 7	16.04 bcde	0.27 a
Leo	15.42 bcde	0.24 a
Zentmyer	14.75 bcde	0.30 a
VC241	14.19 bcde	0.26 a
Thomas	13.44 bcde	0.26 a
Spencer seedling	11.58 bcde	0.26 a
G755A	11.56 bcde	0.21 a
Poly N	10.47 cde	0.21 a
Rio Frio	9.44 de	0.24 a
Spencer clonal	8.24 e	0.26 a
Guillemet	6.26 e	0.30 a

Application of Molecular Markers to Avocado Improvement:

Five objectives:

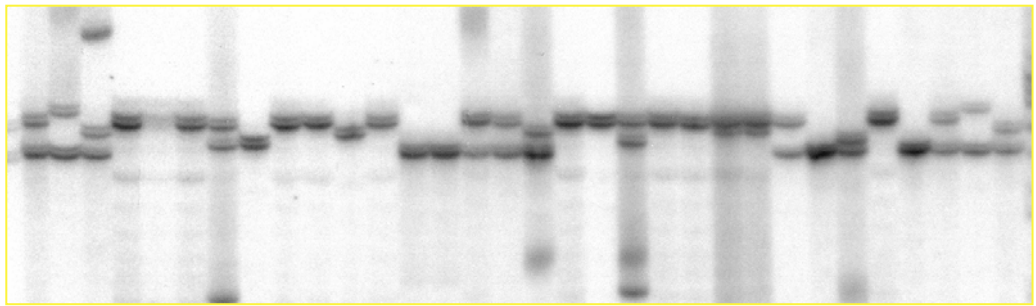
(1) develop a large number of microsatellite or simple sequence repeat (SSR) markers;

(2) map the avocado genome with at least 100 SSR loci;

(3) establish an experimental population for quantitative genetic analysis;

(4) analyze marker-trait associations in this experimental population as a means of identifying major quantitative trait loci (QTL's) of potential commercial value; and

(5) initiate a program of marker assisted selection to accelerate the genetic improvement of commercial avocado.

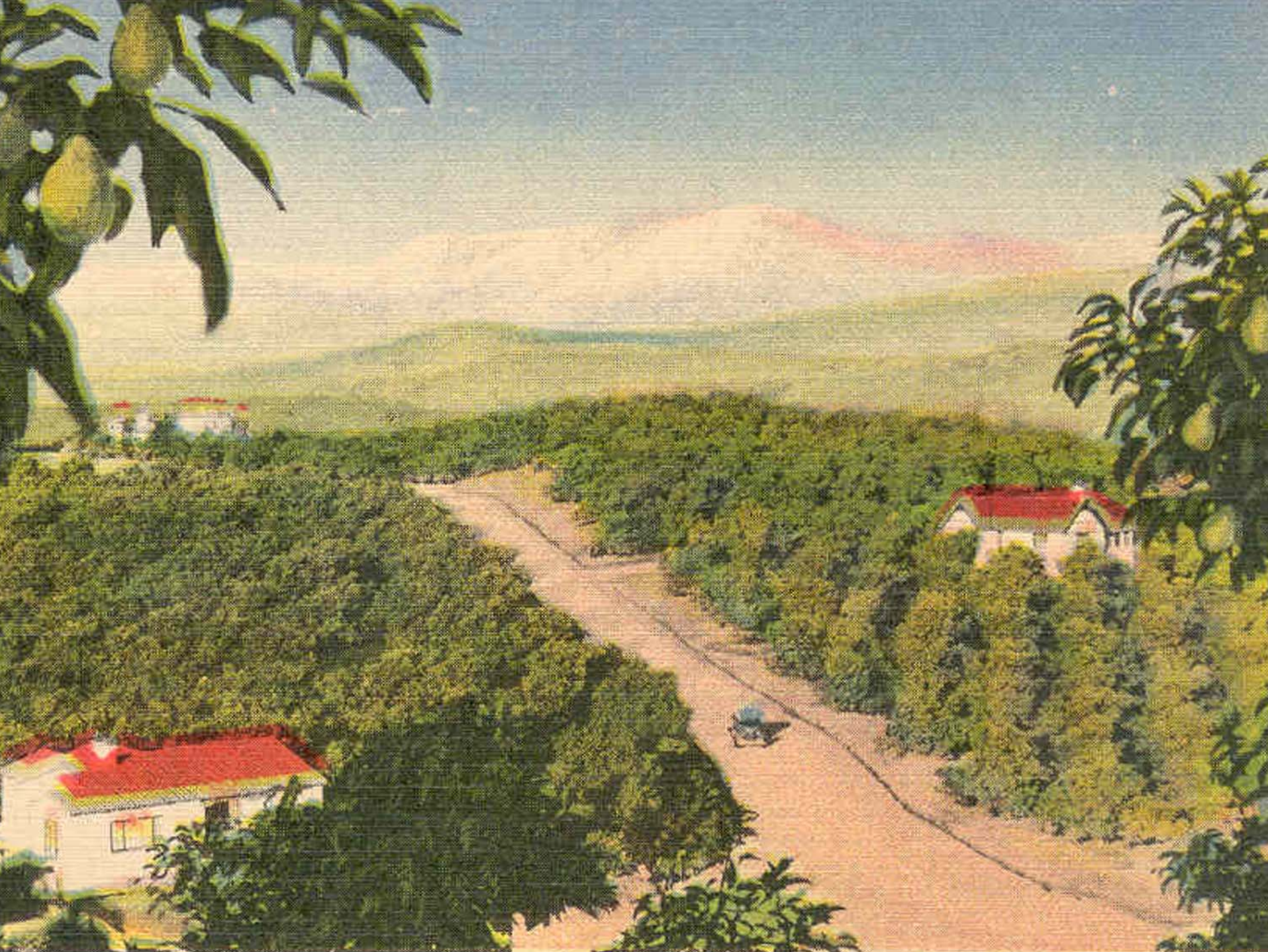


So far have developed a total of 127 microsatellite markers and are now focussing their efforts on the collection of data from an established experimental population:

- 200 Gwen seedling progeny (genotypes)
- Four replicates each on Duke 7 rootstock
- Randomized design
- At two locations, UCR and UC-SCREC

Marker-assisted selection:

- ✓ Identify marker alleles associated with high QTL value.
- ✓ Type markers in seedlings
- ✓ Discard offspring that lack right alleles
- ✓ Evaluate remaining offspring under field conditions




Germplasm Preservation


Questions?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