Avocado Disease Management

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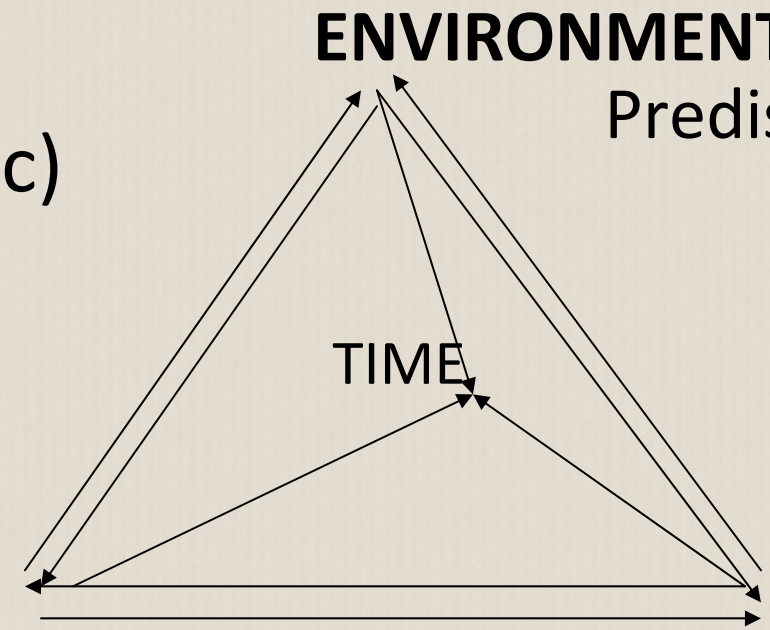
Avocado Disease in California

- Minor Diseases (Unless they happen to be in your grove!)
- The Major Disease, Avocado Root Rot

Disease

- Biotic
- (Abiotic)



Disease Management

ABIOTIC:

Environmental factors that set up a plant for disease

- heavy crop load
- salinity – specific (Cl, Na, B) and total
- water – too much, too little, frequency
- freeze
- grafting
- pruning
- insect attack
- sunburn

Disease Management

Disease can be caused by:

- Primary pathogen – kills outright
- Secondary pathogen – plant can be turned around
- Chronic – can live with it
- Catastrophic – rapid collapse of plant

Anthracnose (brown blotches on leaves)

- Not normally a problem in California, but *can* be with high rainfall
- Caused by a fungus Colletotrichum gloeosporoides
- Fungus is in all groves, grows on dead twigs
- With moisture, spores fall on fruit and leaves

Anthracnose

- Spores germinate or penetrate the fruit causing small black spots, no further development.
- During ripening, fungus resumes growth, causing multiple small rots in fruit flesh, spots coalesce and cause hemispherical rot.
- Control: remove dead wood and prune to open tree for air movement.
- Copper sprays are used in rainy countries.

Avocado Black Streak

- All Guatemalan varieties are susceptible (Hass, Reed, Nabal)
- Only found in California
- Symptoms: canker exuding white powder (sugar) on trunk and main branches

Avocado Black Streak

- Beneath powder are shallow reddish brown lesions that rarely extend into cambium. These can be popped out with a knife.
- Trees rarely die.
- Other symptoms: chlorosis, early bloom, branch die-back, leaf blotching, zinc deficiency, bunchy growth, rapid death of new foliage.

Avocado Black Streak

- Disease seems to be brought on by prolonged periods of environmental or cultural stress – salinity, drought, irrigation practices.
- Once the stress has been identified and corrected, tree recovers.
- Exact cause of disease: unknown but now thought to be related to Dothiorella (Bot.).

Dothiorella Stem and Leaf Blight
"Salt & Pepper Syndrome"

- Indicates under-watering Symptoms show up a few days after a heat spell.
- Can kill young trees.
- Cut out dead material, into fresh green wood.

Dothiorella Canker

- Cause: fungus Dothiorella gregaria, same fungus that causes fruit rot.
- Symptoms: white powder that exudes from the bark and cracking and shedding of the outer bark.
- Symptoms disappear after problem corrected.

Dothiorella Canker

- Disease favored by moisture, keep leaves and debris away from lower trunk, especially if the bud-union is buried.
- Guatemalan varieties are most susceptible.

Avocado Bacterial Canker

Xanthomonas campestris

- Water/Salt related stress can often be corrected by simply altering irrigation distribution.
- Pocket of fluid builds up under the white exudate. When dried up there is a little flap of bark left.

Trunk Canker caused by *Phytophthora citricola*

- Second most important disease in coastal CA.
- Fungus has a wide host range: walnut, cherry, cherimoya and fir.
- Occurs on the base of the trunk.

Disease Management

Where water accumulates, even with a high DU, if it hits the trunk you are sunk.

Trunk Canker caused by *Phytophthora citricola*

- Red resinous exudation when dried, will turn into a white crystalline deposit.
- Beneath the exudation, when cut with a knife, lesion will be orange-tan to brown
- Fungus will grow around the tree in the phloem and cambium, and will ring-bark the tree
- Tree death can be very slow.
- Phos acid trunk sprays frequently correct.

Disease Management

Tea shot hole borer

Fusarium Dieback
Pest/Disease Complex
Slow dieback of canopy
Localized to LA and Israel

An Ecological Disaster Coming our Way

6 months: from infection to collapse

Disease Management

Strings of Compacted Ambrosia Beetle Sawdust

Laurel Wilt Disease *Raffaelea lauricola* fungus

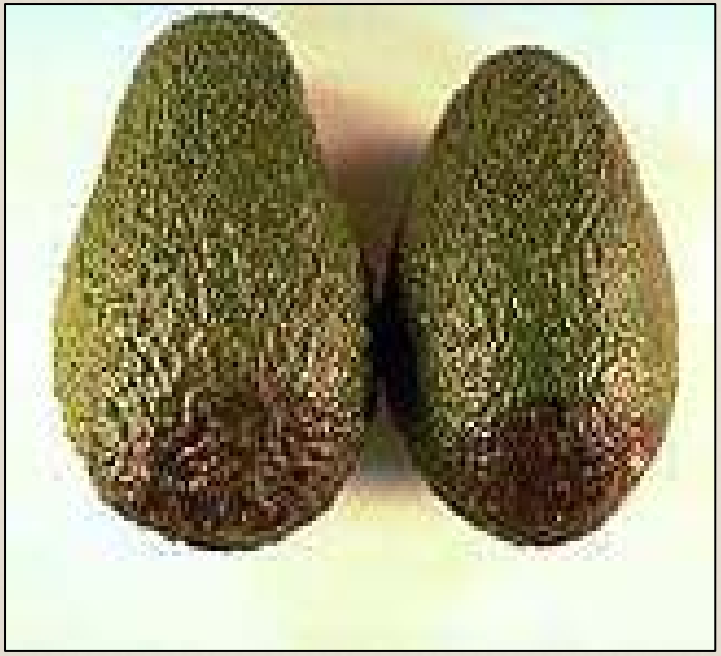
Spread by Redbay Ambrosia Beetle
Xyleborus glabratus

Pest-Disease Complex

- Ambrosia Beetles (>34,000 species world-wide) order: coleoptera usually bore into dead trees
- Characterized by boring into trees and forming galleries in the sapwood.
- Beetle carries the fungus which digests the wood disrupting the flow of water and nutrients.
- The adult and larvae feed on the mycelium and spore clusters of the fungus.
- Typically attack trees under stress (e.g. drought).

It only takes one beetle to cause the infection
Arrived in commercial orchards – Miami, 2012

Avocado Phytophthora Fruit Rot



- Cause: fungus Phytophthora citricola, the same fungus that causes trunk canker.
- Minor disease, brought on by prolonged moist weather.

Phytophthora Fruit Rot

- Symptoms: distinct circular black area that occurs at the lowest spot on the fruit.
- Keep fruit off the ground.
- This disease may increase with pruning to keep fruit lower in the tree.
- No chemical controls registered.

Dothiorella Fruit Rot

- Caused by same fungus as Dothiorella trunk canker.
- Disease does not appear on the tree, but develops in fruit after harvest.
- Starts with small purple-brown spots.

Dothiorella Fruit Rot

- Flesh becomes invaded by the fungus, develops an offensive odor, side rots or stem end rots.
- Fungus increases in population in the grove by growing on dead branches, margins of salt-burned leaves.

Dothiorella Fruit Rot

- Other symptoms: stunted weeping growth, crocodile bark, yellow streaking on young branches. Symptoms will often appear after stress, top-working or freeze damage.
- In severe cases, no or little fruit production.
- Spread by infected graft wood, infected rootstocks, root grafting, pollen, and possibly pruning.

Verticillium Wilt

(one side of tree usually wilts)

- Very dramatic tree decline – days.
- Caused by fungus, *Verticillium albo-atrum*
- Often associated with first warm day of year.
- Often from ground previously farmed with peppers/tomatoes.
- White wash and let tree come back.

Sunblotch

Trunk base

- Caused by infected wood pieces greater than 2” in diameter.
- Typically it takes years to kill a tree, but some strains are more lethal.
- Very sensitive to drying out and to other saprophytes.
- Seen more frequently, old stumps are not removed, but new tree planted near by.

Canopy

Avocado Root Rot – shows thinning foliage
(Phytophthora cinnamomi)

- Most serious avocado disease in California.
- Thrives on excess soil moisture and poor drainage.
- Symptoms: leaves are small, pale green, wilted, can see the sky through the tree.

Avocado Root Rot

- Small feeder roots may be absent, or if present are blackened, brittle and dead.
- The absence of feeder roots prevents the uptake of moisture, the soil under diseased trees stays wet even though the trees appear wilted.
- Pencil sized roots and larger, are not attacked by this fungus.

Avocado Root Rot

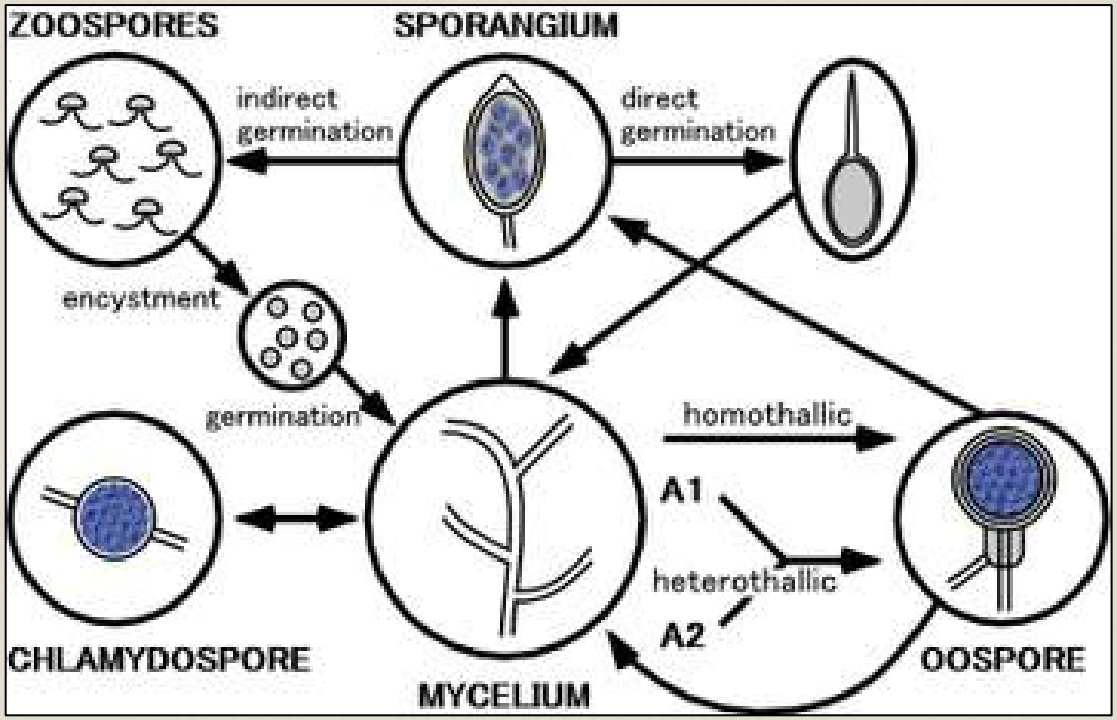
- Trees can die rapidly (we have seen 5 acres die in 3 months during wet years), or very slowly.
- Can be spread into the grove by water (runoff from neighbor or recycled pond water), equipment (ladders, bins, tractors, shovels), shoes, coyotes or dogs carrying infected fruit, hooves of horses and infected nursery stock.
- Seed at nursery should be heat treated.

Disease Management

Phytophthora cinnamomi is everywhere, so growers need to be good irrigators which is the primary defense against root rot.

Disease Management

It is not a fungus but a brown algae with a cell wall of cellulose, not chitin



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Disease Management

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SEMINAR SERIES

Disease Management

Fungal Cellulase production is antagonistic to *Phytophthora*

Methods of Moving Phytophthora

Zoospores in Irrigation Water

Methods of Moving Phytophthora

Soil on Bins and Ladders
(are these grooves necessary?)

Methods of Moving Phytophthora

boots

Methods of Moving Phytophthora

Infected nursery trees

(Beware of 'good deals' or 'close-out' prices)

Avocado Root Rot

- Control: careful irrigation, sick trees should be on a different irrigation block, or have sprinklers with less output until trees recover.
- Control gophers. Water moves rapidly through their runs.
- Barriers to reduce movement of animals.
- Crop rotation to citrus, cherimoya, persimmon, deciduous fruits and berries.

Avocado Root Rot

- Phosphorous acid injection ***works***, but doesn't eradicate the fungus.
- Buffered material is preferred, (0-28-25).
- Acid form is 0-60-0, severe damage to bark.
- Australian recommendation: multiply tree canopy diameter by 15 to obtain total amount of 20% phosphonate product to inject 4m x 15 = 60ml of 20% phosphonate.

Phosphorous Acid, 0-60-0, unbuffered

Damaged trunk

Phosphorous Acid, 0-27-25, buffered

Less trunk damage, uses twice as much product (compared to 0-60-0)

Roots one year after phos acid injection

Disease Management

Roots from non-injected tree,
same disease rating at start of trial

Phosphorous Acid

- Registered in California as a fertilizer.
- Often confused with phosphoric acid, also registered as a fertilizer but this has no activity as an anti-fungal chemical.
- Stimulates a defense response in the tree, e.g. tree produces it's own anti-fungal chemicals in response to the injection of phos acid.
- Possibly stimulates the salicylic acid pathway.
- All brands on the market work equally well.

Avocado Root Rot
Other Important Control Methods

- Mulch heavily with wood chip-based mulch (greenwaste).
- Gypsum applied to soil at 25 lbs/tree.
- Plant in mounds or ridges for re-plants to improve drainage.
- Use clonal Phytophthora-tolerant rootstocks.
- Duke 7, Toro Canyon, Dusa, Latas.

Disease Management

Douhan

Menge

Zentmyer

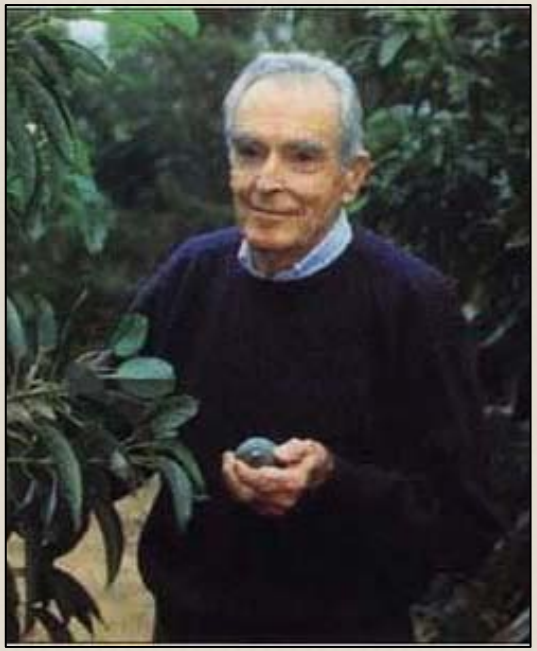


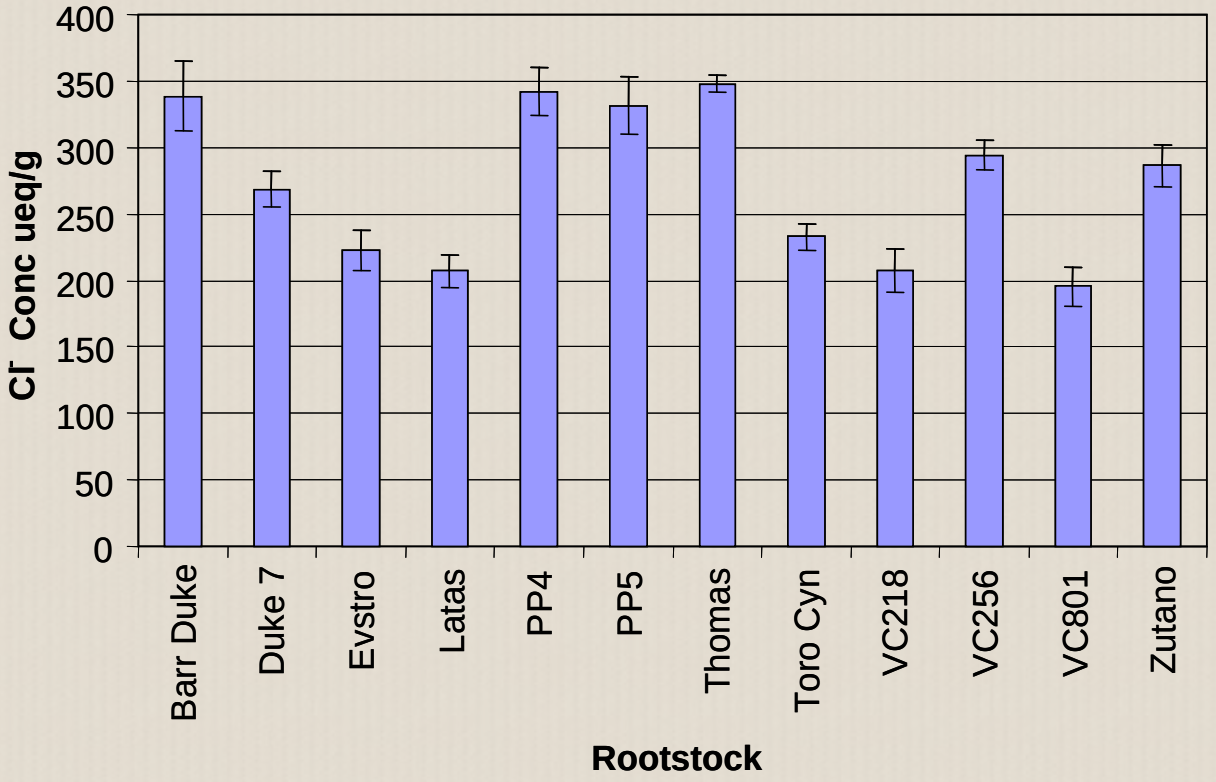
Table 1. Four-year-old field plot in Phytophthora-infested soil in Escondido CA, 2003[1]

Rootstock	Tree rating (0-5; 5=dead)	Canopy volume (cu ft)	Trunk diam. (cm)	Salt Burn (0-5; 5=heavy)	Cankers (0-5; 5=heavy)	Dead trees %
Merensky I	0.00d	551ab	10.7a	0.08cd	0a	0
VC241	0.06d	281efgh	8.0abc	0.03cd	0a	0
RioFrio	0.07d	362efcd	8.7abc	0.00d	0a	0
Zentmyer	0.07d	410bcde	9.2ab	0.32bc	0a	0
Merensky II	0.18d	532abc	9.4ab	0.21dc	0.1a	0
Spencer sdlg.	0.36d	263efgh	6.9bc	0.00d	0a	7
Uzi	0.38d	669a	10.6a	0.68a	0a	6
Steddom	0.39d	478bcd	8.6 abc	0.32bc	0a	7
Thomas	0.47cd	367cdef	8.4abc	0.62ab	0a	6
Leo	0.77cbd	274efgh	7.3abc	0.13cd	0a	13
Guillemet	0.83cbd	190ghi	6.2bc	0.13cd	0a	13
Duke7	1.34cb	127hi	8.8abc	0.16cd	0a	19
Spenser cl.	1.44b	211fghi	5.3c	0.12cd	0a	23
G755A	1.69b	322defg	7.0bc	0.25cd	0a	25
PolyN	4.15a	77i	1.5d	0.06cd	0a	82

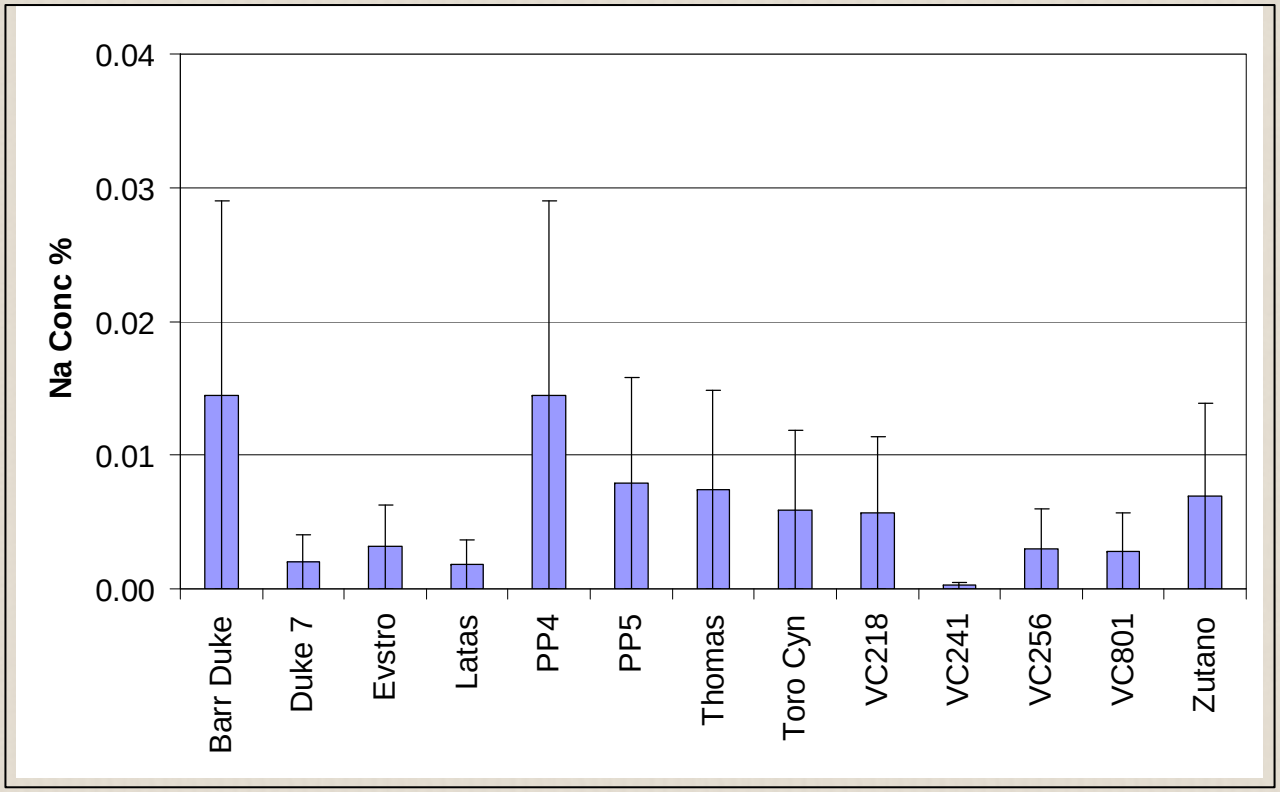
Table 2. Four-year-old drought-stressed field plot in Phytophthora-infested soil in Carpinteria CA, 2003 [1]

Rootstock	Tree rating (0-5; 5=dead)	Canopy vol (cu ft)	Trunk diam (cm)	Fruit set (0-5; 5=heavy)	Canker (0-5; 5=heavy)	Salt Burn (0-5; 5=heavy)	Dead trees (%)
Uzi	0.72 f	167.5 a	6.51 a	3.25 a	0.85 c	2.15 a	6
Zentmyer	1.06 ef	140.0 ab	6.31 a	3.28 a	0.58 c	1.44 ab	0
Merensky II	1.50 def	104.5 bc	5.36 ab	2.63 abc	0.76 c	0.85 b	11
Merensky III	1.71 de	74.4 cde	4.86 bc	1.53 c	1.27 c	0.63 b	11
Merensky I	2.13 cd	72.5 cde	4.83 bc	2.71 ab	1.72 bc	0.63 b	16
Thomas	2.63 bc	77.7 cd	4.12 bcd	2.37 abc	1.12 c	2.12 a	32
McKee	3.29 b	50.2 de	2.85 d	1.61 bc	1.56 bc	1.78 a	53
Merensky IV	3.42 b	36.8 ef	3.47 cd	1.53 c	1.46 bc	0.58 b	32
Aquacate	4.92 a	1.6 f	0.52 e	0.00 d	3.00 ab	0.67 b	84
PolyN	4.95 a	0.7 f	0.34 e	0.00 d	4.50 a	2.00 a	95

Chloride concentrations in avocado leaves
Stehly Ranch, Sept. 2002



Sodium concentrations in avocado leaves
Stehly Ranch, Sept. 2002



Rootstocks

2003 Plantings:

Stehly Ranch
(Valley Center)

- Duke 7
- Spencer
- Parida
- VC 44
- VC 207 (Day)
- VC 801
- VC 218
- PP14 Uzi
- PP16 Rio Frio
- Steddom

Pete Miller
(Santa Barbara)

- Uzi
- Dusa
- Zentmeyer
- Steddom
- Thomas
- Latas

Questions?