

Breeding and Genetics

Screening and Evaluation of New Rootstocks with Resistance to *Phytophthora cinnamomi*

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PROJECT OBJECTIVE

Ultimately, the control of Avocado root rot will be accomplished with resistant rootstocks. Our goal is to find rootstocks that will eliminate *Phytophthora cinnamomi* as a serious pathogen on avocado. Our ability to find such a rootstock has been enhanced as a result of our breeding blocks where we focus on crossing already resistant rootstocks. Our objectives over the life of this project have been to collect, select, breed and develop avocado germplasm that exhibits resistance to *Phytophthora* root rot of avocado. This project has already produced several new tolerant rootstocks (Zentmyer, Uzi, and Steddom), which are greatly improving the yields of avocado on land infested with *Phytophthora cinnamomi* (Figure 1). Releasing this germplasm for California avocado growers is a high priority that I am currently working on with the UC Administration.

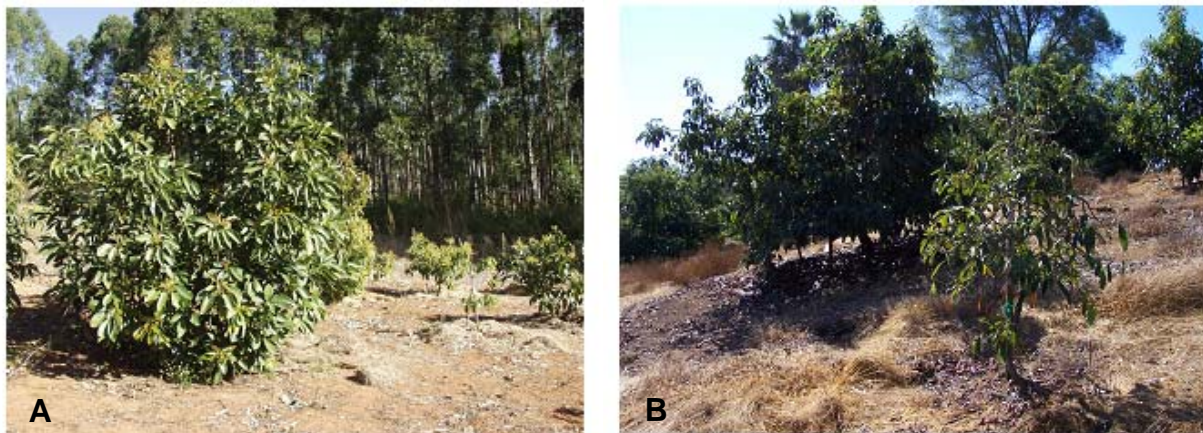
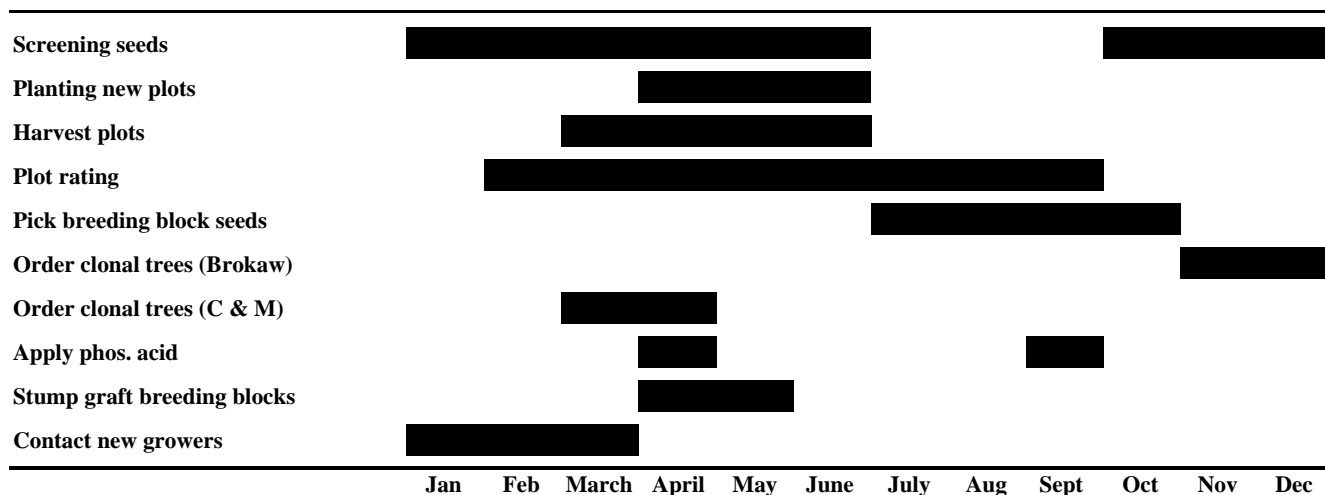


Figure 1. A) Zentmyer rootstock grafted to Hass (left) growing vigorously in root rot infested soil in South Africa next to unknown, but susceptible rootstocks, grafted to Hass. B) Uzi rootstock grafted to Hass (left) growing vigorously in root rot infested soil in Southern California next to Spencer rootstock grafted to Hass that is showing symptoms of *Phytophthora* root rot.

Since this is a long-term ongoing project, I have included in this 2008 report a general timeline that is followed throughout the year so that the growers, Board Members, and PRC Members have a feel for how this program operates (Table 1).

Table 1. Yearly timeline for research involved in this project.



Over the past year we have rated 17 plots but harvest data was only collected from one plot due to the previous years freeze. This was the first year of production for this particular plot and the yield was variable. Last year we planted four plots and have rated them this year. One particular plot has heavy *Phytophthora* inoculum and two newer varieties, Brandon and Eddie, are showing great promise (Table 2; Fig. 2). However, additional years of testing will be required as well as testing these varieties at (continued on page 3)

Table 2. Tree rating from one year old plot in Rancho California

Rootstock	Tree rating (0-5; 5=dead)	Canopy vol (cu ft)	Trunk diam (cm)	Salt damage (0-5; 5=heavy)	Dead trees (%) ¹
Brandon	0.763g	27.40a	2.537a	2.026a	0
Eddie	0.947fg	24.03ab	2.390a	1.263bcd	0
Dusa	1.175efg	18.93bc	2.510a	1.175cd	0
Farwell 1	1.417def	19.70bc	2.383a	1.189ab	0
Campbell	1.658cde	16.21c	2.184ab	1.868ab	0
Farwell 2	1.833 cd	13.42cde	2.350a	2.139a	0
VC241	1.868cd	17.91bc	2.179ab	1.553abc	0
Gray	2.028cd	7.57e	1.917b	1.878d	0
Thomas	2.075bc	15.23cd	2.190ab	2.105a	5
Balou 1	2.700ab	7.36e	1.960b	0.778d	10
Balou 2	2.763a	8.84de	1.821b	1.625abc	16

¹ Dead trees were isolated for root rot and all were positive for *P. cinnamomi*

Figure 2. A) Brandon rootstock grafted with Hass growing under heavy root rot conditions. B) Thomas rootstock grafted with Hass showing significant symptoms of avocado root rot. C) Eddie rootstock grafted to Hass growing under heavy root rot conditions. Thomas rootstock grafted with Hass in the background is showing significant symptoms of avocado root rot.



additional locations in the avocado production areas. Unfortunately, two of the newly tested lines, Balou1 & 2, performed the worst. Therefore, they will likely be dropped from further testing. In the past, poorly performing varieties were often tested over many years. One of the varieties was ordered again for one more trial and if it fails, we will drop both of these so that other advanced lines can be field-tested. We currently have over 40 advanced lines that have undergone approximately two years of greenhouse screening for root rot resistance that have not been field tested and 16 have been generated since I took over as lead PI. All of these advanced lines came from our breeding blocks on the University of California campus (Table 3).

Table 3. Advanced lines that have been developed over the past three years.

Accession #	Mother Tree	Breeding Block
GD 1	PP40 Eddie	16 d
GD 2	PP29 Pond	16 d
GD 3	PP40 Eddie	16 d
GD 4	PP40 Eddie	16 d
GD 5	PP57 Mary Lou	16 d
GD 6	UC 2001	15 g
GD 7	D 7	16 a
GD 8	PP 36 Dirac	16 d
GD 9	Thomas	15 g
GD 10	PP 40	16 d
GD 11	VC 256	16 c
GD 12	D 7	16 a
GD 13	D 7	16 a
GD 14	D 7	16 a
GD 15	D 9	15 g
GD 16	D 9	15 g

This year we planted four new plots for a total of 680 trees. Approximately 5000 seeds from our breeding blocks, including seeds from our large breeding block of advanced lines at the South Coast Field Station, have been picked for initial greenhouse screening under significant root rot conditions. Approximately a third of these have already been screened and we will continue to screen them throughout the year. As I mentioned in my mid-year

report, I now have a graduate student who is now applying molecular techniques to ‘fingerprint’ our tolerant rootstocks to better understand the genetic relationships between them, to be able to choose diverse rootstocks to test under field conditions, and to eventually understand how pollination is occurring in our breeding blocks (long term goal). The first two goals should be attainable by next summer but the latter goal is much more difficult and may require more experienced personnel. She is also working on a molecular method to quantify *P. cinnamomi* from soil and plant material, which may or may not be better than traditional methods. However, this research has not progressed far enough to answer this thus far.

We will also continue to monitor our ‘dwarf’ and ‘salt-tolerant’ breeding blocks because they have not yet begun to produce. Moreover, we have also begun to collect *P. cinnamomi* isolates to determine the genetic variability of the pathogen population so that representative isolates can be used in the greenhouse screening process.

Conclusions

This project continues to move forward to develop rootstocks that are tolerant to *P. cinnamomi* so that California growers have ‘options’ when it comes to choosing which clonal rootstock they would like to grow. For example, we consistently get feed back from our grower collaborators and many seem to have a favorite rootstock that does best under their particular growing conditions. This is not surprising given the variability of soil types, grove topography, as well as management practices. The program thus far has produced rootstocks that are far superior to other rootstocks that the UC has worked on with yields up to 2 to 3 times that of older varieties such as Thomas. We are committed to continue to move forward on rootstock development for the California avocado growers.