1998 California Avocado Research Symposium pages 41-43
California Avocado Society and University of California, Riverside

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

Continuing Project; Year 6 of 20

John A. Menge
Department of Plant Pathology,
UC Riverside

Cooperating Personnel: G. A. Zentmyer, B. Mckee, F. Guillemet, E. Pond, G. Bender, M. Arpaia, B. Faber, M. Crowley, M. Clegg, M. Kobayashi, P. Mauk

Benefits to the Industry

Ultimately, the control of Avocado root rot will be accomplished with a resistant rootstock. This project has already provided the industry with several new tolerant rootstocks which are greatly improving the yields of avocado on land infested with *Phytophthora cinnamomi.* The goal is to find a rootstock that will eliminate *Phytophthora cinnamomi* as a serious pathogen on avocado. Our ability to find such a rootstock has been enhanced manifold as we focus on crossing already resistant rootstocks.

Objectives

To collect, select, breed and develop avocado germplasm which exhibits resistance to Phytophthora root rot of avocado.

Summary

Collection and Selection of Germplasm

For the first time in many years no resistant rootstocks were imported from outside the US in 1997. This reflects the greater effort to utilize material from our own program. We still intend to locate one last avocado species- the Aguacate de Anise from Costa Rica, in order to test its resistance to avocado root rot. Attempts are being made to force budwood from the Rocky tree in San Diego Co., the Hibbard tree at South Coast and the Keenon tree from San Diego. All of these trees exhibit valuable traits.

Breeding Program

We have screened 3869 seeds from the breeding blocks for resistance to *Phytophthora cinnamomi.* While we can handle up to 12,000 seeds per year, we have begun to revamp one of the 16 breeding blocks every year. Resistant trees will be planted in the blocks instead of grafting resistant buds into existing trees. This will allow more uniform plantings, the establishment of replicated trees and prevent shading and suppression of slower growing germ plasm.

We are attempting to synchronize the flowering in the avocado breeding blocks so that varieties flowering at different times have a higher probability of crossing. We therefore have implemented a program of girdling late varieties (*Persea steyermarkii,* CRI-71, G810, G755) and spraying early varieties (Thomas, Toro Canyon, Barr Duke, Duke 7, and UC2011) with Uniconazole-P. The first years results indicate no significant alterations in the flowering times or fruit set due to these treatments. We will continue the treatments another year and increase the rates of Uniconazole-P.

From the material screened this year, we retained 18 seedlings which showed excellent resistance to *P. cinnamomi* in the initial screening. These seedlings have maternal parents of UC2001 (10), G6 (3), D9 (3) and Thomas (2). We now have 22 possible crosses from the breeding program which have shown exceptional resistance to *P. cinnamomi* after extensive testing. Most of these have material parentage of D9 and UC2001. Two of these have been clonally produced and are scheduled for field testing in 1998, and 8 others have been increased and are ready for field testing. Five others will be grafted for increasing budwood in 1998.

We are cooperating with Dr. Clegg to determine how many of our rootstocks from the breeding blocks are actually crosses and how many are selfs. We are also determining the complete parentage of the selected rootstocks from the breeding blocks which show a high degree of resistance.

The breeding blocks are now made up of G755A, Thomas, G1033, Toro Canyon, Barr Duke, UC2001, CRI-71, Duke 7, G6, D9, UC2011, and *P. steyermarkii.* We plan to add the Zentmyer.

Screening and Greenhouse Evaluation of Rootstocks

Extensive greenhouse evaluations were done on clonals PP 4 (maternal parent Barr Duke),PP 5 (maternal parent D9) and Huntales (supposedly without sunblotch). Thomas and Borchard served as the resistant and susceptible controls. *Phytophthora cinnamomi* reduced top growth of Borchard 33%, Thomas 18%, PP 4 4%, Huntales 25% and PP 5 54%. *Phytophthora cinnamomi* reduced root weight of Thomas 20%, Borchard 25%, Huntales 0%, PP4 0% and PP5 51% (Table 1). Percent root health and total root length was also greatest with PP4 and Thomas. However, soil populations of *P cinnamomi* around the roots was highest with PP4, Thomas and Borchard. It appears that PP 4 is an outstanding prospect and may be the first rootstock which has better resistance to *P. cinnamomi* than Thomas. We are going to call the PP 4 the Zentmyer in honor of George Zentmyer who collected most of the material used in the UCR breeding program. Rootstocks selected for intensive testing in 1998 include PP 14 (maternal

parent G6), PP19 (maternal parent UC2001), PP 24 (maternal parent Toro Canyon), Thomas and Borchard. Plants being grafted for intensive studies in 1999 include Poly-N (polyploid from UCLA), W14 (South African), UC2076 (Avocate mico from Guatemala), PP15 (maternal parent Thomas) PP18 (maternal parent Thomas), Thomas and Borchard.

Field Evaluation

In a 7-year-old rootstock trial at South Coast without heavy root rot pressure, the trees yielded in the following order from greatest yield to least yield: Duke 7, Queretaro (Mexico), Dusa (South Africa), Thomas, UC2003 (Escondido), Borchard, D9 (irradiated Duke), UC2011 (Duke-Statom), Spencer (Pauma Valley), CR 1-71 (Costa Rica).Trunk diameters from largest to smallest are as follows: Dusa (South Africa), Borchard, (Duke 7), UC2003 (Escondido), Thomas, Queretaro (Mexico), UC2011 (Duke-Statom), D9 (irradiated Duke) and CR 1-71 (Costa Rica). Only the CR 1-71 (Costa Rica) is performing poorly enough to be eliminated from study.

In a 8 year trial at South Coast without heavy root rot pressure the trees yielded in the following order from the greatest yield to the least yield: UC2009 (Jovo South Africa), Thomas, UC 2001 (Duke seedling), Toro Canyon, UC 2002 (Bar Duke seedling) and Parida (Brokaw). All of these rootstocks are performing adequately.

In a 4-year-old trial in Somis, CA, with heavy root rot pressure, Thomas is significantly larger and healthier than either UC 2011 (Duke-Statom) or Duke 7. UC 2011 (Duke-Statom) is no longer healthier than Duke 7, it appears to be failing. Yield from the Thomas trees are more than twice those of Duke 7. Yields of UC 2011 (Duke-Statom) are intermediate between Thomas and Duke 7. Mulch treatments greatly reduce the difference between Thomas and the other rootstocks. It appears that Duke 7 and UC 2011 (Duke-Statom) benefit much more from mulching than Thomas.

In a two-year-old trial in Camarillo, CA under heavy root rot pressure, trees were rated as follows from the healthiest to the poorest: Spencer (Pauma Valley), VC 256 (Israel), Halma Duke, UC 2023 (G755 C seedling), Thomas, UC 2014 (W-14 South Africa), Borchard, Evstro (Australia) and Gordon (South Africa).Tree size from largest to smallest was: Borchard, UC2023 (G755 C seedling), Evstro (Australia), VC 256 (Israel), UC 2014 (W-14 South Africa), Spencer (Pauma Valley), Thomas, Halma Duke and Gordon (South Africa). Only Gordon (South Africa) appears to be failing.

Reduction in growth of avocado rootstocks caused by *Phytophthora cinnamomi*[1)]

Rootstock	Reduction in root length (%)	Reduction in shoot weight (%)	Reduction in root weight (%)
Thomas	48.10 BC	18.50 A	22.80 A
Borchard	71.40 A	30.30 A	27.60 A
Huntales	55.80 ABC	30.50 A	13.44 A
PP 4 (Zentmyer)	37.10 C	14.60 A	17.70 A
PP 5	66.17 AB	43.67 A	25.50 A

[1)] Values followed by identical numbers are not statistically different according to Waller's k-ratio t test.

A 1-year-old trial at Carpinteria, CA with G755A *(P. schiedeana x P. americana* seedling), Evstro (Australia), Velvick (Australia) and Spencer (Pauma Valley) has not yet been evaluated.

A 1-year-old trial in Somis, CA under heavy root rot pressure, was rated as follows from the healthiest to the poorest: Thomas, Spencer (Pauma Valley), Evstro (Australia), and Velvick (Australia). Tree sizes from largest to smallest were: Thomas, Evstro (Australia), Spencer (Pauma Valley), Velvick (Australia)

A new trial was established in Somis, CA. It contains PP4 (Zentmyer, maternal parent Barr Duke), PP5 (maternal parent D9), Evstro (Australia), Thomas, Duke 7,and *G755A(P. schiedeana x P. americana* seedling). It has not yet been rated.

A new trial was established in Escondido, CA. It compares Spencer (Pauma Valley) as a seedling rootstock with Topa Topa. It has not yet been rated.

Several new field trials will be established in 1998 in sites in Ventura and San Diego counties. These trials will include: PP4 (Zentmyer, maternal parent Barr Duke), PP5 (maternal parent D9), VC 256 (West Indian, Israel), VC 207 (West Indian from Florida via Israel). Spencer (Pauma Valley), Dusa (South Africa), Latas (South Africa), Evstro (Australia) G775A *(P. schiedeana x P. americana* seedling), Rio Frio (Guatemala), Poly-N (polyploid from UCLA), VC 241 *(P. nubigena* from Israel), W14 (South Africa), Bailey (Brokaw) and Ballard (Brokaw).

Avocado varieties being propagated for 1999 field trials include UC 2076 (Aguacate mico, Guatemala), W14 (South Africa), Dusa (South Africa), Latas (South Africa), Evstro (Australia), Spencer (Pauma Valley), Poly N (polyploid from UCLA), PP4 (Zentmyer, maternal parent Barr Duke), PP14 (Maternal parent G6), PP19 (maternal parent UC 2001), PP24 (maternal parent Toro Canyon), PP15 (maternal parent Thomas), G775A *(P. schiedeana x P. americana* seedling), Thomas and Parida (Brokaw).

Conclusions

It appears we may have a rootstock which surpasses Thomas as the most root rot resistant. It is PP4 (maternal parent Ban-Duke), which we propose to name the

Zentmyer. We are continuing study on other promising rootstocks including Evstro (Australia), Dusa (South Africa), Spencer (Pauma Valley) and G755A *(P. schiedeana x P. americana* seedling). Rootstocks which have performed well under greenhouse conditions include Latas (South Africa), Poly-N (polyploid from UCLA), Huntales (w/o sunblotch) and W14 (South Africa). Because of the success of our first UCR breeding plot material we are increasing our efforts with these varieties.