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SCREENING AND EVALUATION OF NEW ROOTSTOCKS WITH RESISTANCE TO *PHYTOPHTHORA CINNAMOMI*

J. A. Menge
Department of Plant Pathology
University of California
Riverside, CA 92521

Cooperating Personnel:
G. A, Zentmyer, E. Schieber, F. Guillemet, E. Pond, E. Johnson, S. Campbell, D. Ferrin, B. Bergh, W. Casale, G. Martin, G. Bender, G. Witney, M. Arpaia, B. Faber

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

1. Collection and selection of germplasm

During the past year Dr. Schieber has provided us with 99 collections from Guatemala and these have been processed. The collections include 81 Guatemalan criollo *(Peresa americana),* 11 West Indian *(Persea americana),* one Aquacate de Mico, two *Persea steyermarkii, Persea nubigena,* and three *Persea schiedeana.* None exhibited exceptional resistance to root rot. We are trying to locate fruit from *Persea rigens* which has not yet been tested. In addition seven rootstocks with known resistance to *P. cinnamomi* have been imported from Israel. These are being increased for further testing.

Rootstock budwood has been forced from the Spencer and Hibbart trees in San Diego county which have shown excellent resistance to Phytophthora.

2. Breeding program

We have screened 4115 avocado seedlings from Dr. Bergh's breeding program during the past year. From these tests we retained 66 seedlings which appear to have good resistance. We now have a total backlog of 91 seedlings which must be propagated for further testing. Most of these are D9 seedlings or crosses with D9 as a parent. Others of interest are Spenser seedlings or crosses between Barr Duke and Thomas. Because of last year's freeze it is estimated we have only about 1200 seedlings to test this year. We had expected 8,000. Most of these are from G6 or D9 parents. Several trees were killed in last year's freeze. Gray Martin has repaired the damage and the trees are currently at the same stage as they were prior to the freeze. The plots are now made up of G755A, Thomas, G6, G875, G810, D9, G874, Borchard, Steyermarkii, G1033, Toro Canyon, Barr Duke, UC2001 and CRI-71.

3. Screening and greenhouse evaluation of rootstocks

Extensive greenhouse evaluations were done on clonals of UC2002, UC2003, UC2011 and D9. Thomas and Borchard served as controls. Reduction in root dry weight and root length caused by *P. cinnamomi* was far less with D9 and UC2011 than with the other rootstocks. Stem growth and the % healthy roots during the 6-month experiment was significantly greater for D9 and UC2011 than the other rootstocks. *Phytophthora* populations associated with the roots were greatest in Borchard and UC2002 and the least in UC2011. Lesion size caused by *P. citricola* was greatest in Thomas and the lesion sizes of the other rootstocks were not significantly different. Root uptake of nutrients did not vary between the rootstocks. It appears that UC2011 may be very resistant to *P. cinnamomi* root rot.

4. Field evaluations

Results from a survey of 16 avocado groves planted to Phytophthora-tolerant clonal rootstocks on *P. cinnamomi* infested soil gave the following results. All Phytophthora tolerant rootstocks performed better than Borchard. Thomas gave the best overall performance followed closely by D9 and Barr Duke. Toro Canyon and Duke 7 exhibited moderate resistance to *Phytophthora.* G755 did not perform well at most sites and many trees exhibited leaf chlorosis, thin canopies and poor fruit set. Some G755 trees, especially those on warmer sites, appeared to be doing well. All rootstocks exhibited low amounts of P, Cu, and Zn in their foliage indicating that certain nutrient sprays may assist in the establishment of Phytophthora-tolerant rootstocks.

Field results in one plot established by Dr. Coffey in 1989 indicate that Toro Canyon, Thomas, UCR2001 and UCR2011 are performing well. G755 is growing well but the foliage is thin and chlorotic. Barr Duke and Duke 7 appears to have moderate resistance. UCR2009, G1033 and UCR 2002 are performing very poorly. In a second trial at South Coast established in 1990 with UCR2001, UCR2002, UCR2009, Thomas, Toro Canyon and Parida, little differences have been noted. However, Parida is exhibiting severe chlorosis.

Two field plots were established this past year: 1) South Coast (Orange co.) with UCR2003, UCR2011, Queretaro, Thomas, Duke 7, Borchard, D9, CRI-71, Dusa and Spenser; 2) Goleta (Santa Barbara co.) with UC2001, Thomas, G755, and UCR2003.

Following last year's freeze evaluations were made of frost tolerance on avocado rootstocks established at Riverside. Temperatures reached 31, 29 and 24°F on the 21, 22 and 23 of December, respectively. In order of least frost damage to greatest frost damage the rootstocks were Thomas, D9, G6, Barr Duke, Topa Topa, Duke parent, Fuerte, Duke 7, Rincon, Wurtz, Susan, Duke 6, Zutano, G1033, Nabal, Hass parent, Bacon, G755A, Reed, Anaheim, G755B, Lulu, G22, McArthur, Hass Prince and G755C. Thomas and D9 were virtually unaffected by the frost while McArthur, Hass Prince and G755C were defoliated and many branches were heavily damaged.

5. Resistance mechanisms

At least five types of avocado resistance to Phytophthora root rot have been identified. 1) Barr Duke and Duke 7 appear to have reduced root exudation which can attract Phytophthora zoospores; 2) Thomas exhibits rapid root growth when challenged with *Phytophthora',* 3) All rootstocks exhibit some brown roots. These roots are partially resistant to *P. cinnamomi.* The resistance factor in brown roots is limited to the very thin outer tissue; 4) Highly resistant chemical responses to *P. cinnamomi* have been identified in *Persea cinerascens* and *Persea borbonia.* These chemical responses stop lesion development after 72 hrs; 5) The speed of lesion development in Barr Duke and Thomas is reduced compared to Topa Topa or Borchard. This effect is thought to be a weakened form of number 4 above. In general, our resistance mechanisms available in Duke 7, Barr Duke and Thomas are poor and will provide field resistance only under optimal conditions or when relief is provided with improved cultural conditions or chemical treatment.