

Quick Decline Studies

rootstock investigations test various top-root combinations in search of tolerant citrus varieties

W. P. Bitters and E. R. Parker

The second of two articles on quick decline as influenced by top-root relationships

Two sets of rootstock experiments were set up to determine the tolerance of certain top-root combinations to quick decline.

In 1945 and 1946, 620 trees of various top-root combinations were planted as replants in the quick decline area of the Azusa-Covina district. Ten rootstocks were included. All trees were exposed to natural infection by the quick decline virus, and the trees in one orchard were also inoculated with buds from diseased trees.

In 1948, 2,112 trees of Valencia oranges on 125 different rootstocks—1945 seed—were planted at Baldwin Park. Half of the trees were inoculated with buds from diseased trees.

In the 1945-46 plantings trees generally grew slowly, probably because they were frequently planted in orchards which were due for removal and had poor care. Symptom expression was initially less pronounced than on the trees at the Baldwin Park planting. At Baldwin Park the inoculated trees on some rootstocks were much more readily affected by inoculation with quick decline virus than others. By August, 1950, 41.6% of

the inoculated trees at Baldwin Park were affected while 10.1% of the check trees were infected by the vector. Trees on some of the roots—such as sour orange or shaddock—appeared to be more seriously affected by natural infection than those on roots of the mandarin hybrids, trifoliate orange hybrids, and others.

Most of the inoculated trees made less growth than the check trees, in many cases the only observed effect of inoculation. Growth was reduced in trees on the roots of sweet orange, some of the mandarin, and trifoliate hybrids; but not on some of the lime stocks, Rough lemon, and a few other roots.

The conclusions as to the tolerance to quick decline of Valencia trees on the various stock combinations are in many cases tentative.

The results are principally based upon inoculation trials made in test plots and may not be typical of results obtained under conditions of natural infection.

Sour and Sweet Oranges

Twenty varieties of sour orange were used as rootstocks for Valencia oranges.

Valencia oranges on sour orange roots. Left, uninoculated; Right, inoculated tree showing stunting, small leaves, partial defoliation and fruit set.

Some trees in each of these combinations developed quick decline symptoms. In both plantings the bittersweet group of sour orange appears to be more susceptible than the standard sour group. Two years after inoculation 70.7% of the inoculated trees at Baldwin Park showed symptoms, compared to 20.7% of the checks. The possibility of finding a variety of sour orange tolerant to quick decline seems highly improbable.

The growth of trees on 12 of the 14 varieties of sweet orange stocks was reduced on the inoculated trees at Baldwin Park. In general the check trees and the trees in the 1945-46 plantings appear healthy. Only a few of the inoculated trees—except a selection of the Bessie variety—developed mild symptoms similar to those of quick decline. However, the condition of some of the inoculated trees on sweet root has not improved, and the stunting effect is accompanied by small leaves and partial defoliation.

Shaddocks and Hybrids

The shaddocks used as stocks for Valencia orange are very susceptible to quick decline. The nine shaddocks tested appear to be equally susceptible and show symptoms about as rapidly and to the same degree as trees on sour orange roots. Symptom development was slower in the 1945-46 plantings.

Trees on the shaddock x sweet orange hybrid stocks developed symptoms earlier and to a more severe degree than those on the sour orange stocks. Growth of the inoculated trees as compared to the uninoculated trees was reduced more than in any other group of combinations. The fact that sweet orange was one of the parents of the hybrid did not make the hybrid less susceptible.

Grapefruit and Limes

Many of the inoculated orange trees on grapefruit stock at Baldwin Park show symptoms of quick decline and reduction in growth. These effects are sufficiently severe to classify these stocks as susceptible, although symptoms are milder and slower to appear than on sour orange stocks. In the 1945-46 plantings sweet



orange trees on grapefruit roots occasionally showed mild symptoms.

Valencias budded on acid or mandarin-type lime stocks appear to be tolerant to quick decline two years after inoculation. Trees on the Palestine sweet lime and a lime-orange hybrid appear to be susceptible.

Lemon and Hybrids

Among the lemons, lemon hybrids, and several lemon-like selections only three out of 14 varieties appear to be tolerant when used as stocks for Valencias. These are two common varieties of Rough lemon and a Rough lemon type from India. Symptoms are very pronounced on some of the lemon—Eureka and Lisbon—and lemon-like roots. Trees on two selections of Khouzb-el-Arsa and the Rabat—possibly a hybrid of lemon x sour orange—appear to be even more susceptible than trees on sour orange stock.

Mandarins and Hybrids

Valencias on the mandarin stocks are slightly stunted by the inoculations. The degree of stunting is comparable to that on sweet stock and is accompanied by small leaves and thin foliage. The Kinokuni and Willow Leaf varieties are the most severely stunted and the Cleopatra mandarin the least. The uninoculated check trees of these varieties and uninoculated trees on King mandarin in the 1945-46 plantings are healthy.

Some mandarin hybrids appear to be tolerant, others susceptible, as stocks. Symptoms are milder, and slower to appear than in trees on sour orange roots. Trees on nearly all 20 mandarin-hybrid

Valencia oranges on Sampson tangelo roots. Left, uninoculated; right, inoculated, stunted tree. All trees were photographed two years after planting. Measuring standard is a two-meter rod.



Valencia oranges on grapefruit roots. Left, uninoculated; Right, inoculated tree, stunted and with small leaves.

varieties are stunted. The inoculated trees on San Jacinto tangelo and two tangors—hybrids of Willow Leaf x Valencia and Willow Leaf x Blood orange—are not appreciably reduced in growth and have developed no symptoms. The trees on Kara show no symptoms other than moderate stunting. Two selections of Thornton tangelo, a tangor—hybrid of Owari satsuma x Valencia—Owari tangelo, Minneola tangelo, Sexton tangelo, and Sampson tangelo appear to be susceptible. The trees on Sampson tangelo root in the 1945-46 plantings displayed only

a lack of vigor. It may be that all oranges budded on tangelo are susceptible combinations and that the trees on the San Jacinto have escaped infestation or have not as yet developed symptoms.

Trifoliate Orange Hybrids

Mild symptoms resembling quick decline are present on a few trees on roots of most varieties of trifoliate orange. The inoculated trees on most trifoliate stocks are stunted, but some difference between varieties is apparent. A tetraploid strain appears least satisfactory, the Rubidoux and Pomeroy strains most promising in tolerance. The appearance of the inoculated trees has improved after the first onset of symptoms.

Among the hybrids a citremon appears most susceptible. A few trees on each of these roots show varying degrees of stunting accompanied by small leaves and thin foliage. The condition of such trees tends to improve. None of the check trees are affected. Trees on the Morton citrange and Troyer citrange in the 1945 planting are healthy and vigorous, showing no indications of decline.

Miscellaneous Stocks

Some of the inoculated trees in this group on the Ichang pummelo and Ichang lemon have developed more severe symptoms and display the greater stunting. Trees on the Yuzu and Kansu are least affected, and their appearance is generally improving.

Trees on *Citrus moi* still appear toler-

Continued on page 16



NEW PUBLICATIONS

—now ready for distribution—

Single copies of these publications—except the Manuals—or a catalogue of Agricultural Publications may be obtained without charge from the local office of the Farm Advisor or by addressing a request to: Agricultural Publications, 22 Giannini Hall, University of California, College of Agriculture, Berkeley 4, California.

LEMONS AND LEMON PRODUCTS: CHANGING ECONOMIC STATUS, 1951-52, by Sidney Hoos and R. E. Seltzer, *Calif. Exp. Sta. Bul. 729*. Provides information helpful in adjusting to conditions so the fresh and products markets may be developed and expanded.

PRUNING ORNAMENTAL TREES, SHRUBS, AND VINES, by W. H. Chandler and Ralph D. Cornell, *Extension Service Circular 183*.

PEACH VARIETIES FOR A WARM WINTER CLIMATE, By J. W. Lesley and M. M. Winslow, *Circular 406*.

THE BORDER METHOD OF IRRIGATION, by James C. Marr, *Circular 408*.

DECLINE

Continued from page 11

ant. Those on *Citrus macroptera* and on the Bigaraldin are susceptible.

Observations are being continued and plantings of trees on additional roots added. The grower is advised not to plant trees unless their susceptibility to quick decline has been determined; and to buy trees from a reliable nurseryman who can provide a past history of the top-root combination.

W. P. Bitters is Assistant Horticulturist, University of California College of Agriculture, Riverside.

E. R. Parker is Horticulturist, University of California College of Agriculture, Riverside.

The above progress report is based on Research Project No. 1382.

WEEVIL

Continued from page 5

represented only one season's work, it would appear advisable for the nurseryman in the San Francisco Bay area to treat for *Brachyrhinus* early in April and early in May. More extensive tests are being made on a commercial basis this spring.

A. Earl Pritchard is Assistant Professor of Entomology and Parasitology, University of California College of Agriculture, Berkeley.

The above progress report is based on Research Project No. 1318.



Penalty for private use to avoid payment of postage, \$300

University of California College of Agriculture, Agricultural Experiment Station, Berkeley 4, California

Paul J. Sharp
Director

Free—Annual Report or Bulletin or Report of Progress
Permit No. 1127

DONATIONS FOR AGRICULTURAL RESEARCH

Gifts to the University of California for research by the College of Agriculture accepted in February, 1952

BERKELEY

Heckathorn and Co.	10 lbs. 50% wettable chlordane	
	For experimental purposes on garden centipede	
Loring Hoag	5 lbs. rose clover	
	For establishing range pasture test plots	25 lbs. Smilo
H. D. Hudson Mfg. Co.	Admiral Duster No. 766	
	For experimental work on control of poultry mites	
Julius Hyman Co.	50 lbs. P 162	
	5 lbs. emulsifier	
	5 gals. P 162	
	1/2 gal. emulsifier	
	For use in fumigation studies of crown gall bacteria in soils and control of Armillaria and Dematophora root rots	
Lederle Laboratories Division of American Cyanamid Co.	50 mg. aminopterin	
	For embryonic research	10 ampules leucovorin
Merck & Co., Inc.	20 mg. crystalline vitamin B ₁₂	
	For nutritional research	
Naugatuck Chemical	\$233.35	
	To support residue analysis on samples of fruits and vegetables, that have been processed, for the purpose of flavor evaluation	
Niagara Chemical Co.	1 3-lb. bag Niagrathal weed killer	
	For establishment of weed control plot on cereals	
Staten Island Co.	100 lbs. wheat	
	For studies dealing with biology of insect pests attacking stored grains	

DAVIS

American Potash Institute, Inc.	1 ton potassium sulfate	
	For continuation of work on orchard soil fertility	
Dr. James A. Berry	laboratory articles	
	For the Division of Food Technology	
Cal. Com. Rel. of Electricity to Agriculture	\$3,125.00	
	Continuation of support of investigations on uses of electricity in agriculture	
California Turkey Growers Assn.	turkey hatching eggs	
	For experimental purposes	
Canners League of California	\$99.08	
	Continuation of investigations on the production of seed of asparagus varieties 499 and 500	
Donsing Poultry Breeding Farm	200 S.C.W.L. male chicks	
	For experimental purposes	
Ed Heitman	1 registered Duroc gilt	
	For use in the breeding herd	
Jackson & Perkins Co.	135 started eye rose plants of Mardi Gras variety and license to grow same for cut flowers	
	For testing and research in flower production	
Lederle Laboratories Division of American Cyanamid Co.	aureomycin in HCL crystalline 50 grams	
	For experimental purposes	
Eli Lilly and Co., Research Department	two one-ounce bottles of "Merthiolate" substance	
	To aid studies on microbial chitinase	
Linde Air Products Co.	1 lb. polyethylen powder	
	For experimental purposes	
Producers Cotton Oil Co.	200 lbs. cottonseed meal	
	For experimental purposes	
William J. Stange Co.	4 ozs. parsley oil and 4 ozs. celery cleoresin	
	For experimental purposes	
C. M. Volkman & Co.	4 lbs. of Merion Bluegrass B27	
	For research in turf management	

LOS ANGELES

Amling-DeVor Nurseries, Inc.	36 "Better Times" rose plants	
	For floricultural research	
Valley Rose Nursery	50 "Better Times" rose plants	
	For floricultural research	

RIVERSIDE

Rohm and Haas Company	\$3,000.00	
	To continue support of investigations for the purpose of promoting the development of agricultural insecticides and fungicides and the screening of samples and the field testing of promising compositions	