

RESISTANCE OF THE DUKE VARIETY OF AVOCADO TO PHYTOPHTHORA ROOT ROT

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The susceptibility of various rootstocks to the serious Phytophthora root rot disease of avocado trees has been tested in a number of experiments over the past several years. Included have been tests in the glasshouses and lathouses on the Riverside campus, using infested soil, as well as nutrient solutions and, more recently, a number of field tests. From these investigations, two things are apparent: (1) the Duke variety of Mexican avocado has appreciable resistance to root rot, and (2) several species of *Persea*, not closely related to the avocado, have high resistance.

Regarding the first point; in 1951, a series of tests was begun in our lathouse at Riverside, using large concrete beds containing soil from around diseased trees. In these beds, large numbers of seedlings of avocado and of other species of *Persea* have been planted. The first planting consisted of seedlings of 22 varieties of avocado; six plants of each were included. Most of these seedlings were provided by Dr. F. F. Halma, then at U.C.L.A. In this planting, we obtained the first indication that seedlings of Duke possessed at least some degree of resistance. Five of the original 6 Duke seedlings planted in this soil infested with *Phytophthora cinnamomi* in 1951 are still alive (May, 1956); two of these are making excellent growth, the other three are slightly to moderately affected with root rot. Approximately 95 percent of the other seedlings in this test are either dead or in advanced stages of disease. One of the 6 Edranol seedlings is still in fair condition, and one Quaker seedling is only slightly affected with root rot. Duke is the only one of the 22 varieties in which a significant percentage of the plants has remained alive.

In a second lathouse test, in which seedlings were transplanted to a similar bed of infested soil in 1952, Duke seedlings also showed appreciable resistance. Of 23 Duke seedlings planted in this test, 12, or 52 percent were still free from top symptoms of root rot when this experiment was concluded in 1955. The healthy seedlings were transplanted from this bed for further tests. None of the other 19 varieties of avocado or species of *Persea* showed appreciable resistance. Results of this test are presented in Table 1.

Table 1. Results of tests of resistance of avocado varieties and species of *Persea* to *Phytophthora cinnamomi* in lathhouse at Riverside.

Variety	Number of seedlings planted in 1952	Number healthy 1955
Duke	23	12
Persea borbonia	15	4
Ward	15	0
Fuerte	15	0
Spinks	23	0
Topa-Topa	23	0
Dutton	23	0
Panchoy	16	0
Kashlan	23	0
Tiger	15	0
Dickinson	15	0
Dorothea	15	0
Dickey A	15	0
Mayapan	15	0
Persea floccosa	15	0
Persea indica	15	0
Knight	8	0
Sharpless	8	0
Persea schiedeana	8	0
Lula	8	0

A third test is still continuing in another bed containing soil from around severely diseased trees. Here, again, Duke is the only one of five avocado varieties showing resistance to root rot. In this test, 110 seeds of each variety were planted directly in the infested soil in February, 1953. Eighty-nine of the Duke seed germinated; of these, 41 are not yet showing symptoms of root rot. Two of the other varieties have one healthy seedling remaining and two have no healthy seedlings, (see Table 2.)

Table 2. Results of tests of resistance of avocado varieties to *Phytophthora cinnamomi* in lathhouse at Riverside.

Variety	Number of seed planted, 1953	Number germinating	Number of healthy seedlings, 1956
Duke	110	89	41
Topa Topa	110	98	1
Nowels	110	66	1
Irving	110	82	0
Tantlinger	99	81	0

In resistance tests in nutrient solution, which simulate extremely severe disease conditions, no such striking differences have appeared between Duke and other varieties. This indicates that Duke may have only moderate resistance, and that this rootstock might not survive under severe disease conditions in the field. Insufficient numbers of plants have been tested by the nutrient solution technique, however, further tests involving large numbers of Duke seedlings and cuttings are planned for later this year.

The evident occurrence of at least some resistance in the Duke variety indicates the possibilities of selection of even more resistant types through several methods, and propagation of the more promising selections vegetatively. Through the cooperation of Mr. E. F. Frolich of the Department of Subtropical Horticulture, U.C.L.A., cuttings have been propagated from the resistant Duke types appearing in the lath-house tests mentioned above, Frolich has made these cuttings using essentially the method which he described in the 1951 Yearbook (1).

Preliminary results from 5 field plots, established in San Diego, Los Angeles, and Santa Barbara counties in the spring of 1955, also indicate some promise for Duke as a resistant rootstock. In these plots, Fuerte trees budded on various rootstocks, Duke cuttings, and seedlings of species of *Persea* were replanted in areas where avocado trees had been removed because of root rot. Three of these plots are under conditions of what might be termed moderate infection. Disregarding for the moment the *Persea* species, the Duke cuttings propagated by Frolich from resistant seedlings in our lathhouse tests look best in these plots, followed by the Fuertes on Duke seedlings. It is evident that the Duke materials are not as resistant as are *Persea Skutchii* and *P-borbonia*, but Duke is compatible with other avocado scions, whereas the *Persea* species are not. Condition of the trees on these three plots one year after planting is shown in Table 3. These are obviously very preliminary results:

Table 3. Condition of avocado varieties and *Persea* species replanted in soil infested with *Phytophthora cinnamomi*. Data taken one year after planting from plots in San Diego and Santa Barbara counties.

Material	No. of trees	No. with Root rot	Average Stage ¹ of Disease
<i>Persea Skutchii</i>			
seedlings	6	0	0
<i>Persea borbonia</i>			
seedlings	4	0 ²	0
Duke cuttings	13	2	.5
Fuerte on Duke	17	6	.9
Fuerte on Hass	18	8	1.5
Fuerte on Topa Topa	17	10	2.1
Fuerte on Mexicola	12	11	3.0

1. Scale for stage of disease: 0 healthy, 5 dead.

2. *P borbonia* seedlings did not have root rot, but made very poor growth.

In the other two plots, planted under very severe disease conditions, the Duke cuttings are showing some resistance, but the Fuerte trees budded on Duke seedlings are in very poor condition, similar to those on the other rootstocks. *Persea Skutchii* is showing high resistance.

Zentmyer and Schroeder have presented evidence of the resistance of *Persea Skutchii* and *P. borbonia* to *Phytophthora* root rot (2,3). Unfortunately, these species are not compatible with the avocado. Tests during the past year at Riverside and in Guatemala show that *P. Donnell-Smithii* also has high resistance. This species was obtained in the cooperative program, financed by the California Avocado Society, between the Institute Agropecuario Nacional in Guatemala and the University of California Citrus Experiment Station at Riverside. There are indications, however, that this species is not compatible with the avocado.

Other possibilities for useful resistance, at present, include several vigorous, apparently healthy trees growing in areas where most of the surrounding trees have died or are severely affected with root rot. Cuttings from rootstock sprouts from two such trees, noted in Orange County by Dr. Arthur Wallace, and by J. A. Deutel in Los Angeles County, have been propagated by E. F. Frolich. These are being tested for root rot resistance at Riverside, and appreciable numbers will be planted in the field next season for further tests.

CONCLUSIONS

The preliminary results of field trials bear out the indications obtained in glasshouse and lathhouse experiments that the Duke variety has moderate resistance to *Phytophthora* root rot, and that under extreme disease conditions, the variety may have insufficient resistance. The Duke variety seems to offer promising possibilities for further selection and testing, however. This provides the first indication of appreciable resistance in material compatible with commercial avocado varieties.

Persea Skutchii, *P. borbonia*, and *P. Donnell-Smithii* all have high resistance to root rot, but are not compatible with avocado scions. Possibilities for hybridization to secure both resistance and compatibility are evident.

Propagation of the rootstocks, from apparently resistant old trees in the field, offers another possibility for obtaining resistant material. Several such collections are now available, but have not yet undergone sufficient testing.

LITERATURE CITED

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