Avocado Rootstock-Scion Studies

compatibility between avocado and new rootstocks suitable to California is object of plant program

C. A. Schroeder and E. F. Frolich

The imperative need for new avocado rootstocks—with disease resistance and other desirable characteristics, such as dwarfing habit—is the reason for a program of introduction and establishment in California of many avocado forms and botanical relatives.

The problem of propagation and compatibility in horticultural plants is often complicated and difficult of solution. Experience has shown that predictions concerning the success or failure of combinations of forms or species are unwarranted. Sometimes forms which appear to be related are difficult to graft. Others unite readily but may be short-lived or otherwise incompatible. This is illustrated in the avocado by the behavior of the Lyon and Murrieta Green varieties when grafted on Mexican race rootstocks. These two typical Guatemalan varieties can be grafted on Mexican stock successfully, but the resulting grafted trees are frequently dwarfed or short-lived. The same varieties propagated on Guatemalan or hybrid rootstocks or in combination with Guatemalan or hybrid intermediate stem pieces appear to be quite successful in the few trees of these combinations available for observation.

The opposite condition, apparent compatibility of diverse forms, is illustrated by the combination of the *Persea longipies* and the Mexican avocado—*P. drymifolia.* The former species has a small, thin, glossy leaf, thin willowy branches, and small, very thin-fleshed fruit which appears to be only remotely related to the Mexican avocado, the latter having large leaves and branches and relatively larger fruit. Yet this combination appears to be quite congenial, and *P. longipies* as a scion is among the most vigorous of many observed as a nurse-limb.

Observations of these combinations and others in the field and experimental plantings strongly suggest that all combinations between forms and species must be investigated by grafting and budding before definite conclusions can be reached concerning the specific compatibility of any two. Even after a union between two forms has been successfully initiated, the longevity of and the subsequent production from this combination must be determined for a period of years before a conclusion can be reached concerning the ultimate compatibility of specific combinations.

Early avocado rootstock investigations at Los Angeles were concerned with compatibility and included important commercial varieties and several allied botanical forms and relatives. Among the latter were the native bay—*Umbellularia californica*—a distant botanical relative of the avocado; the Grecian laurel—*Laurus nobilis;* and the common camphor tree—*Cinnamomum camphora.* Repeated trials of grafting and budding the avocado on these species resulted in failure.

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Fuerte and Hass scions growing on *P. floccosa* root.

***Persea* species utilized in compatibility experiments with avocado. *Left to right:* Coyo—*P. Schiedeana*—from Guatemala; swamp bay—*P. borbonia*—from Louisiana; *P. indica*, from Canary Islands; and *P. gigantea*, from Honduras.**

Chloride Toxicity in Avocados

tests show chloride absorption and toxicity vary with the seedling variety and the form of nitrogen

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In many avocado orchards, the tips of the leaves—and in severe cases the leaf-margins also—become brown as the leaves reach full maturity. Tissue-yellowing usually precedes the leaf-burn, and the extent of leaf-burn depends on the nature of the seedling variety and concentration of chloride in the leaf tissue.

As the leaves develop, their accumulating of chloride may be very gradual, and often only upon their reaching full maturity will the leaf-burn at the tip—the terminus of the leaf-veinal system—become evident. When the irrigation water contains considerable chloride, the usual practice is to depend upon the rainfall to leach the chlorides to depths below the root zone, but unfortunately an adequate depth of soil, drainage, and rainfall is often lacking. When in addition to an excessive chloride concentration there is also present an excess of sulfate, sodium, and other elements, and an inadequate supply of calcium and magnesium, it is then that leaf injury becomes most severe.

A chloride-affected leaf of a Topa Topa—Mexican variety—avocado seedling grown in a sand culture with a nutrient solution which contained 422 parts per million—ppm—of chloride added as calcium chloride is shown in the picture on this page. Leaf injury from chloride accumulation often results in the premature abscission of the affected leaves.

A preliminary test was made to determine the effectiveness of various forms of ammonia nitrogen in reducing the injury brought about by chlorine. Earthenware containers of three-gallon capacity and provided with drainage were used for sand and soil cultures in the glasshouse. An avocado seedling was

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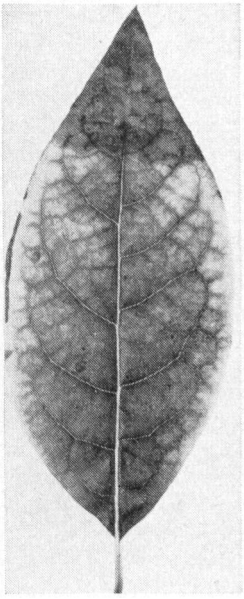

Leaf of a Topa Topa — Mexican — avocado seedling grown in a sand culture, the nutrient solution of which contained 422.3 ppm chlorine. Leaf-burn begins at the tip where the leaf veins terminate and if severe, may proceed along the leaf margin, a yellowing of the tissue often indicating the extension of the burn.

ROOTSTOCK-SCION

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Subsequent introductions of the swamp bay—*P. borbonia*—native to the Gulf Coast states; *P. lingue*, from Chile; the coyo or chinnini—*P. Schiedeana; P. nubigena*, of Guatemala; and *P. melanocarpa*, from Mexico, provided new materials for the study. The coyo, *P. nubigena*, and *P. melanocarpa* were readily propagated on avocado. However, complete failure resulted from all attempts to grow the swamp bay and *P. lingue* on avocado root or to obtain the reciprocal combinations.

Recent collections from Central America, Mexico, Peru, and Puerto Rico have provided additional materials for further study of this problem.

Introductions of new avocado materials from foreign countries frequently are made as scions. These are usually topworked into nurse trees for fruiting, which requires a variable time period.

In order to quickly multiply the material for testing purposes, it is frequently necessary to root cuttings from the nurse-limb introduction. A method for rooting these materials has been developed which utilizes etiolation of the stem section which causes the roots to form.

Attempts to graft some combinations have met with varying degrees of success. The following species have been grafted or budded easily and successfully on avocado: *P. floccosa; P. longipies, P. Schiedeana, P. gigantea, P. nubigena*, and *P. melanocarpa*. The introduced forms Parramos, Coscometepec, Tochimilco, Maltrata, Santa Engracias, Chimaltenango, Acultzingo, Chichoy, Comyagua, Prior, and Aguacate mico are easily grown on the common avocado.

Other combinations have failed regardless of efforts to combine them by budding or grafting and by utilizing the species either as rootstocks or scion in combination with the avocado. Among those which appear to be completely incompatible with the avocado by ordinary methods of propagation are the swamp bay—*P. borbonia*—*P. indica, P. skutchii, P. lingue*, the California bay, the Grecian laurel and the common camphor tree.

Because of its apparent resistance or immunity to the causal organism of avocado root rot—*Phytophthora cinnamomi*, the swamp bay—*P. borbonia*—has been of especial interest as a potential rootstock for use in soils which have poor drainage or which are infected with the cinnamon fungus. Numerous attempts to graft or bud the avocado on *P. borbonia* have failed. Some buds of this combination have remained alive for more than a year but never developed beyond the length of ½″. The rather distant botanical relationship of this species of swamp bay to the avocado—*P. americana*—apparently precludes congeniality between the two. Other species, such as *P. gigantea, P. nubigena, P. floccosa, P. longipies, P. Schiedeana* and the form Aguacate mico, which are quite easily grafted on avocado, have also been found impossible to graft on *P. borbonia*, indicating a condition of incompatibility between these forms.

While *P. indica* and *P. lingue* have been shown to be incompatible with the avocado, these two species have been successfully grafted on swamp bay—*P. borbonia*.

One objective of these studies is to obtain an intermediate or sandwich stem piece which is compatible both with the avocado and disease-resistant or dwarfing rootstocks.

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