A Case of Rootstock-Scion Incompatibility in Peaches*

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Excellent reviews of the literature on compatibility of stock and scion varieties of pome and stone fruits have been published by Argeles (1) and by Gardner, Bradford and Hooker (3). Therefore, no general review will be included in this discussion. The authors cited in those reviews agree, in general, that incompatibility or incongeniality are relative terms ranging from complete lack of union between stock and scion, to such a degree of ability to unite and succeed in growth that "the union is perfect and the behavior of the grafted plant the same as that of an entire ungrafted plant."

These authors generally distinguished between compatibility and adaptability. The latter term is applied to the relation of the combined stock and scion to the environment. When both stock and scion are each suited to the prevailing environmental conditions, but will not thrive when grafted, then compatibility is considered to be limited or lacking. Another author is quoted as stating that "whereas adaptability to environment may often be predicted, compatibility has to be determined by actual test." It sometimes may be difficult to differentiate between compatibility and adaptability. Furthermore a high degree of compatibility in the nursery may not necessarily be synonymous with success in the orchard.

Peaches and nectarines for commercial use have generally been propagated on peach seedlings grown from pits of commercial varieties or from a few especially selected rootstocks such as the nematode resistant types S-37 and Shalil. There have been relatively few compatibility problems when the rootstocks mentioned have been used. Bregger (2) in 1948 reported on differential peach varietal incompatibility when using Yunnan seedlings as understocks. His studies reported that "the Elberta group of varieties" showed consistent compatibility with the Yunnan seedlings, whereas varieties descended from J. H. Hale and South Haven were highly incompatible with the Yunnan seedlings. The incompatibility was characterized by weak top growth on June budded trees, and foliage that was "yellow, spotted and somewhat crinkled."

About 20 years ago M. A. Blake of the New Jersey Station suggested the use of "red leaf" peach seedlings as understocks for peach. The "red leaf" character of the understock would make it possible to eliminate from the nursery row all trees on which the inserted bud failed to take. Such rogueing of "bud failures" is difficult when green leaf understock is used. Blake reported that "redleaf" seedlings were of vigorous and uniform growth, but that germination of the pits sometimes was erratic. Trees budded on "redleaf" seedlings were smaller in size than trees of the same varieties worked on "greenleaf" understocks, but appeared to give satis-

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factory performance in the orchard.

The peach orchard at V. P. I. had several young trees of "redleaf" peaches in 1948 when the author joined the staff. Two of those were of root sucker origin from trees in which the inserted bud failed. Three were obtained from other sources. Study of these trees indicated that although they were similar in many respects they did differ noticeably in the intensity of the red pigmentation in the foliage, size of fruit, amount of pigment in the fruit, pit adherence and vigor. One, which appeared to be more vigorous than the others, bore fruits which were freestone, whereas the other trees bore fruits that were clingstone. It originated as a sucker from the roots of a tree on which the bud failed. Tests indicated that the pits of this freestone variety germinated at least as well as the pits of the other trees; and since the pits were much easier to remove from the fruits, it was saved and trees were propagated from it to provide pits for rootstock use. It was designated as V. P. I. 55.

Since 1952, "redleaf" pits have been planted each year to produce seedlings for budding along with pits of two "greenleaf" natural seedlings identified as Moore Seedling and V. P. I. 56. Germination of the pits was good in all years except that pits from the 1957 crop, a year of severe blossoming season frosts, gave almost no germination. The seedlings from V. P. I. 55 were always uniformly vigorous. The peach budders did note a tendency for the bark of the "redleaf" seedlings to "slip" a bit less readily than the bark of the "greenleaf" seedlings used, and the stems or trunks of the "redleaf" seedlings were noticeably more slender. In spite of these differences the "take" of buds on the "redleaf" seedlings was usually at least as good as the "take" obtained on the "greenleaf" seedlings.

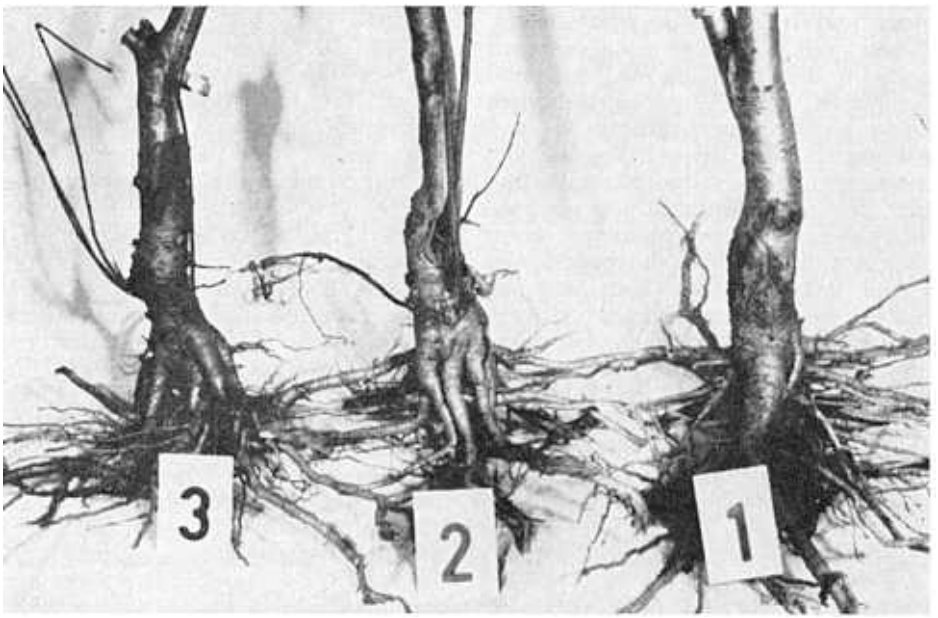

Fig. 1. Representative specimens of trunks and roots of peach trees budded on redleaf rootstocks, at Blacksburg, Va.

Growth of the trees budded on "redleaf" seedlings always started off as rapidly the following spring as growth of the trees on the "greenleaf" seedlings, but slowed down noticeably earlier than the growth of the trees on "greenleaf" roots. A marked yellowing of the foliage was observed on some of the trees on "redleaf" roots as growth stopped. Beginning with 1955, a series of dry summers have occurred. Since then, the decrease in growth and the early yellowing of the foliage, accompanied by a red spotting and crinkling of the leaf blade has become more pronounced. In several recent years some premature dropping of leaves has occurred from the trees on "redleaf" stock. The trees have withstood the winters satisfactorily, however, and when transplanted to the orchards have usually made satisfactory growth for the first two or three seasons, but gave evidence of being of more dwarfish growth habit than the trees on "greenleaf" roots. After bearing a crop or two of fruit, some of the trees on "redleaf" stock showed evidence of pronounced loss of vigor. Some of the trees growing on thin soils, or in areas of low fertility, became so weak they died or were discarded.

Figure 1 shows the roots of five year old peach trees budded on red leaf seedlings. The root growth on these trees, though somewhat restricted in distribution and depth of growth, was reasonably satisfactory. The rather shallow top soil on which these trees grew is underlain by a dense subsoil, which probably influenced root growth and development. Trees 2 and 3 show characteristic development of suckers from the rootstock. Tree 1 developed a small sucker from the rootstock in 1960, which established the identity of its rootstock as being a redleaf seedling. On the basis of trunk diameter and overall volume of top growth, these trees were approximately two-thirds the size of other five year old trees growing nearby that were budded on green leaf rootstocks. On the basis of observations on other peach and nectarine trees which were known to have been budded on red leaf rootstocks, the three trees shown here would probably have begun to decline rapidly in vigor and probably would have died after two or three more full crops of fruit.

Figure 2 shows longitudinal sections of the trunks of trees 1 and 2. These sections also show the obvious overgrowth of the rootstock over the scion. Gross study of the area of union of stock and scion shows little evidence of abnormal tissues. The wood growth at the point of union appears sound and free from structural weakness. Except for the upper ends of the rootstock stems (which ideally should have been cut more closely to the points of bud insertion), there is very little dead or defective appearing tissue in the trunks. Trunks of trees on "redleaf" rootstocks that are in more advanced stages of decline do show more extensive areas of necrotic tissue, but these appear to be a result of the incompatibility rather than a cause of it.

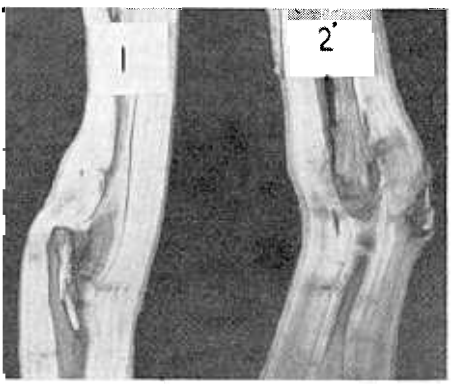

Fig. 2. Longitudinal sections of the trunks of peach trees 1 and 2 shown in Fig. 1, budded on redleaf peach rootstocks.

Trees on "redleaf" roots were supplied to several growers in Virginia and also to other experiment stations during the early years of the use of this rootstock. Reports of trees declining in vigor and eventually dying were received from some of the cooperating growers. Complete records of the rootstock on which trees were propagated were not kept until 1960. Therefore, in many cases it was not possible to be certain that a given tree had been propagated on a redleaf seedling unless suckers arose from the roots of the tree. Probably one-half of the trees known to be propagated on "redleaf" seedlings have developed such suckers from the roots.

The use of this "redleaf" stock certainly is not desirable. The obvious solution lies in discontinuing commercial use of this particular clone of "redleaf" seedlings as a rootstock. This was done in 1962. It still would be desirable to know why such apparently closely related stock and scion material should exhibit such pronounced incompatibility. In addition to the usual physical barrier or interference to free translocation of nutrients through the point of graft union, which often accompanies graft incompatibility in plants, other possibilities suggest themselves, including the possibility of a symptomless, seed transmitted virus carried by the "redleaf stock."

Literature Cited

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More on the Spartan Apple

Interest in the apple variety, Spartan, appears to be growing in areas where McIntosh thrives. D. V. Fisher, of Summerland, B. C., reports that in his area Spartan is vigorous, and yet a very early bearer, and can be expected to produce 1000 bu. per acre at seven years of age, when propagated on dwarfing stocks, and planted at the rate of 200 trees per acre. Although the fruit is large on young trees, it gets small on older trees, and requires thinning.

Spartan is harvested in British Columbia a day or two before Delicious. If picked earlier, the fruit has poor storage quality.

Stewart Bartlett Pear

The Stewart Bartlett is a sport of Bartlett pear discovered in Wenatchee, Washington, which has been found to be somewhat resistant to fire blight in the West. H. J. Brooks, of the Crops Research Division of the U. S. D. A., reports in the Plant Disease Reporter, Nov. 15, 1964, that Stewart Bartlett at Beltsville, Maryland, has not shown this resistance to fire blight.

Observations of three year old trees of this variety at Beltsville indicated that seven out of ten trees were seriously infected with blight, while only two out of ten Bartlett trees of the same age and in the same plot were infected. Brooks concludes that Stewart Bartlett is not resistant to fire blight under eastern conditions.

According to the N. J. Crop Reporting Service the leading apple variety in New Jersey in 1944 was Rome Beauty, with 25% of the total crop. Stayman Winesap ranked second with 17.6%. Golden Delicious declined from 7.2% in 1963 to 3.8% in 1964.