A STUDY OF SOME UNPRODUCTIVE CHERRY TREES IN CALIFORNIA

By C. F. Kinman

Pomologist, Office of Horticultural Crops and Diseases, Bureau of Plant Industry, United States Department of Agriculture

INTRODUCTION

Observations made in California over a period of years have disclosed an interesting problem regarding unproductive cherry trees. An occasional tree, or portion of a tree, has been found that produces practically no fruit, yet branches of the same tree, or other trees of the same variety standing beside it, have been consistently prolific. The behavior of these unproductive trees suggests the presence of a virus disease such as mosaic, but the results of the studies thus far conducted indicate that from a commercial standpoint they may be treated as a result of bud variation. The Black Tartarian is the only variety of cherry widely grown in California in which the occurrence of this unproductive strain is frequent. In orchards of this variety it is common to find 1 tree in 10 made up entirely or largely of the unfruitful type of wood, and much higher percentages have been noted. Occasional trees of the Bing, Lambert, Black Eagle, and other varieties have been found with leaves much like those of the unproductive Black Tartarian. Affected trees of these varieties have been found bearing considerable fruit, but it is misshapen and not marketable.

The conditions under which the productive and unfruitful Black Tartarian trees are growing appear to be identical, and in some instances the two types of trees are so close together that their branches overlap. (Fig. 1.) Trees of the unproductive strain have been found in all the orchards in central California where a search for them has been made, and they have also been found in southern California and northern Oregon. Not all cherry-growing localities in these latter districts have been searched carefully for affected trees.

The presence of 7 trees that were made up entirely or almost entirely of unproductive branches was recorded in one orchard in 1924, 17 in another orchard in 1925, and an additional 94 in a third orchard in 1926. In these orchards there are, respectively, 200, 190, and 980 trees of the Black Tartarian variety. A number of the trees that failed to fruit had been top grafted or removed from the first-mentioned orchard before these records were made. Many trees of the same type have been observed in other orchards. None of the affected trees or branches examined have improved and become productive, although the condition has become more noticeable on some trees with the growth of the affected branches.

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LEAF SYMPTOMS

The shape and color of leaves on the unproductive trees differ from those on productive trees, the blossoms are defective, and many blossom buds fail to open. "Curly leaf trees," "wild trees," and "male trees" are terms frequently used by growers to describe the unfruitful strain. The leaves produced by these trees have large or small areas that are somewhat dwarfed, and this dwarfed condition sometimes causes pockets or drawn places in the leaves which give them a wrinkled appearance. To one familiar with these irregularities, the affected leaves present an unnatural appearance even from a distance of two tree spaces. Affected leaves are distinctive in shape. (Fig. 2.) The margins are very irregular, due to the lack of development of some part of the leaf. This dwarfing may affect the end or part of the end of the leaf, the side or part of the side, or the entire leaf. The dwarfing may vary considerably in severity in different parts of the leaf. The dwarfed places range in size from small spots to areas that include almost the entire leaf. Sometimes they appear as narrow strips instead of spots and extend out from the midrib. Many leaves have more than one, and occasionally there are several dwarfed places in a single leaf. Sometimes only a small segment of the leaf fails to develop normally, causing a notch in the margin. This dwarfed condition is often more pronounced along one side of the leaf than the other, and sometimes one side fails almost entirely to develop while the other side appears to be normal.

In color the leaves of the unproductive trees differ from those of the normal leaf. With the unproductive tree there is a characteristic mottling, as the dwarfed areas are a lighter green than the remainder.
of the leaf. The margins of the light-green areas are not always well defined around the entire periphery, and sometimes the spots fuse with one another or gradually disappear into the darker green portion of the leaf. These light-green areas are present when the leaf first unfolds in the spring, and they appear to result from the lack of development of chlorophyll rather than from discoloration. Outside the light-colored area the leaf is often a darker green than the normal Black Tartarian leaf. The two extremes of color and the dwarfing of the light-green areas of the leaf are sufficiently striking to enable an experienced observer to recognize the unproductive tree readily.

![Figure 2](image-url)

The failure of the leaf, or a part of it, to reach normal size results in a much lower average leaf area on the unfruitful trees than on the normally fruitful ones. Measurements of leaves taken from a 15-year-old tree which has borne almost no fruit and where the malformation is thought to be about average for unproductive trees show that the average leaf area is only three-fourths that of a normal tree standing beside it. On some of the less vigorous of the unproductive trees the leaves appear to roll more during dry weather than those of productive trees, while leaves of the more vigorous ones appear to roll less. The effect of drought on the leaves seems to be determined rather by the vigor of the tree than by the trouble that causes the abnormal development of the leaves.

The extent of mottling and the irregularity in the shape of the leaf of the unproductive strain are sometimes less pronounced on the leaves of shoots that are produced during the summer than on those grown from the buds that open in the spring. Instances have been noted where leaves that grew during the summer were affected but
little if any, whereas all leaves of the same tree that grew early in the spring and in the spring following were decidedly abnormal.

At least an occasional affected leaf was found on the majority of the Black Tartarian trees examined, although on many of these trees no other trace of the malady was apparent. Sometimes the affection was limited to only a few leaves or to the leaves on an occasional spur or branch, and in other cases it was displayed over much of the tree. On the so-called unproductive trees normal leaves and normal fruits could also be found. Some Black Tartarian trees appeared to be entirely free from the off-type leaves.

**GROWTH AND BLOSSOMING**

In orchards where observations have been made, including those not yet in bearing and others up to more than 20 years of age, there appears to be no difference in the rate of growth between the normal and the unproductive trees. Trees of both types standing side by side have been observed, but no consistent difference in size of trees of the same age has been noted. Occasionally a tree of the unproductive strain is larger than its neighbor, and sometimes smaller, but usually it is about the same size. In one orchard, which contains 190 trees of the Black Tartarian variety, the largest tree is made up mostly of affected branches.

The unfruitfulness of the trees under discussion is not due to their failure to blossom, for they bloom profusely and at the same time as the productive trees. Many of the blossoms are defective, however, and smaller than those of normal trees. The peduncles are short, the petals small, and the pistils short and slender with a tendency to dis-color early. Many of the pistils fail almost entirely to make any growth. (Fig. 3.) Among the discolored pistils some turn brown before the blossoms open, some soon afterwards, while some retain their normal color for a few days. Now and then a pistil is observed that appears to develop like those on fruitful trees. An occasional fruit is found on unproductive trees, but it is small, rough, and ill shaped. (Fig. 4.)
Although the unfruitful trees blossom profusely, some of the blossom buds that are formed fail to open. The buds at and near the terminals of spurs and shoots produce their blossoms, while those nearest the base of the previous year's growth often fail to open fully. (Fig. 5.) These buds usually swell but stop growth about the time the scales open and the green-bud clusters appear. The swollen buds turn brown and become dry, but often remain in place on the shoot or spur for several weeks.

SOIL AND CULTURAL CONDITIONS

In some orchards where unproductive trees have been under observation there is considerable variation in thrift and production among the trees due to soil or cultural conditions, but in none of the cases observed can the peculiarities of the unproductive trees be attributed to these causes. In some orchards the accumulation of soil moisture during part of the year is responsible for considerable variation in the thrift of the trees. In these orchards a stratum of hardpan underlies the surface soil at a depth of from 2 to several feet, preventing a free filtration of water. This results in an accumulation of soil moisture during the winter months when rainfall is usually plentiful, and occasionally also after summer irrigations. In these places where conditions for growth are unfavorable some trees have died, others have made but little growth, and the yield of fruit and size of leaves have been below normal. The peculiarities of the unproductive trees under discussion are not, however, such as are found in these wet places, nor are they the symptoms commonly found in soils unsuitable to root growth. Trees of the unproductive strain are not more numerous in such places than where satisfactory conditions for growth prevail.

In a study of the distribution of unproductive trees throughout the orchards there was no indication that the local environment was responsible for their behavior. A few of these trees were found more or less grouped in different parts of the orchards, but as frequently
they were scattered singly over large orchards. In some orchards only an occasional unproductive tree was found; in others they were numerous.

In a few of the orchards under observation a number of trees have been injured to such an extent by the application of stable manure that many of their branches have died. The annual growth on these trees has been very short, and the leaves are small. Many of the leaves on the upper and outer branches are light-green or yellowish in color. The unthrifty appearance of these trees differs, however, from that of the unproductive strain, and none of the abnormal characteristics of the unfruitful trees are found on those injured by the manure. Some of the unproductive trees studied are in orchards that have been given manure, and others are in orchards that have received none.

Figure 5.—A branch of an unproductive Black Tartarian cherry tree on which the flower buds below the terminals of the shoots and spurs failed to open

EFFECT OF TOP GRAFTING AND BUDDING

A number of trees of the unproductive strain which were recognized by growers have been either removed or top grafted with scions from productive trees, both of the Black Tartarian and of other varieties. This explains why there are not more of them found in some Black Tartarian orchards. In all instances observed the new tree tops which followed grafting have been normally productive and free from any of the malformation of leaves, blossoms, or fruit common to the off-type trees. Where shoots have been allowed to grow from the portion of the branches that remained after the tree was headed back for grafting, the leaves produced by them have manifested the same irregularities in shape and color that were found on the tree before it was headed back, although the growth from the scions has been healthy and productive. Shoots which grow from recently cut-back unproductive trees make a rampant growth, and their leaves develop to a large size, but this has not prevented the development of the characteristics of the unproductive tree in them.
For experimental purposes a few trees of the unproductive strain of the Black Tartarian variety were top grafted in 1928 with scions from both productive and unproductive Black Tartarian trees, both types of scions being inserted into the same tree. Several branch stubs in each of a number of trees were grafted in this way. As the scions grew all those from the productive trees produced normal leaves, and all those from the unproductive trees displayed the same characteristics as the tree from which they were taken. Neither in their first nor second year’s growth have the leaves of any of the scions changed in their habit of growth, but they are the same in appearance as those of the parent trees.

In the spring of 1929 the scions from productive trees produced numerous blossoms, all of which appeared to be normal and set fruit of normal shape which grew to maturity. Many of the flower buds of the scions from the unproductive trees failed to open, and many of the blossoms which opened were small, had short unthrifty pistils, and none of them set fruit. A number of branches were allowed to remain on the top-grafted tree when its branches were cut back for grafting; and as the trees were headed back at a height of about 5 feet, numerous small branches and spurs are still growing on the stock portion of the tree. Neither the pruning done in heading the tree back nor the top grafting has affected the habits of these remaining branches. They are unproductive, and the leaves and blossoms are of the same unthrifty type as those produced before the branches were headed.

Attempts were made to transmit the faults of the unproductive strain by budding. Buds from this strain of Black Tartarian were inserted in nursery seedlings in the spring of 1928. The growth from these buds exhibited the same faults as the trees from which the buds were taken, while that on the check trees was normal.

UNSUCCESSFUL ATTEMPTS AT TRANSMISSION BY OTHER MEANS

Efforts to transmit by other means the abnormal development in unfruitful trees have been unsuccessful. Branches of fruitful and unfruitful trees growing side by side have been fastened together in such a way that the leaves would rub one another as the branches were moved by the wind; juice from affected leaves of different ages has been expressed and immediately applied to healthy leaves of different ages, some of which had been pierced and some just slightly scratched to break the epidermis; healthy and affected leaves on adjoining branches have been pinned together and left remaining on these branches; but no indication has been observed that any of the leaf symptoms that accompany unproductiveness have been transmitted.

A number of instances where fruitful and unproductive branches are growing side by side on the same tree have been under observation for three successive years. (Fig. 6.) During this period the performance of none of the branches has changed. The unproductive branches, with their unthrifty leaves, have remained the same, while the productive branches have been healthy and prolific. There is no indication that the position of the branches on the tree influences their behavior.
The occurrence and prevalence of off-type leaves and unfruitful branches in the varieties of cherries studied resembles the condition found in some of the common variegated plants on which occasional normal leaves, twigs, and branches occur.

FIGURE 6.—Unproductive (left) and productive (right) branches growing side by side on the same Black Tartarian cherry tree

PREVENTIVE AND REMEDIAL MEASURES

From the observations thus far made it appears that the unproductive trees are a strain of a variety that has resulted from the propagation of "sporting" branches or "variegations," and if such is the
case the trouble may be evaded by care in the choice of propagating wood. Since the irregularities in the leaves are less noticeable in the fall than earlier in the season, and leaves of shoots that are produced during the summer often display only a trace of the trouble, the location and labeling of propagating wood may be most surely and easily done before the fruit is harvested.

Whatever may be the cause of the trouble that results in the failure of the trees to fruit, the removal, by pruning, of affected branches and by top grafting where the entire tree or a considerable portion of it is affected are effective remedial measures. The selection of propagating wood from productive trees appears to be a satisfactory preventive measure.