

The Nature of Sun-Blotch and its Practical Control*

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HISTORY AND CAUSE

The avocado disease known as sun-blotch has been observed in California for some 20 years but the place of its origin has not been discovered. It is now regarded as one of those diseases caused by a virus, that is, something which is not visible in the microscope but which exists in the living parts of the diseased plant and can be transferred to a healthy plant and cause the disease to appear in the formerly healthy plant. Early workers called the virus a "fluid contagium." Sun-blotch appears not to affect any plant except the avocado. In some respects it seems to resemble scaly bark or psorosis of citrus, although the symptoms most frequently seen are not very similar.

EVIDENCE THAT SUN-BLOTCH DISEASE IS CAUSED BY A VIRUS

When a sun-blotched scion is established in a healthy stock, the growth from the scion is diseased. Also, suckers from the stock show sun-blotch. Healthy scions set in diseased stocks become diseased. The only sure way to avoid the disease is to make certain that both scions and stocks are healthy. Prevention is possible but no method of curing diseased trees is known.

NATURE OF VIRUSES IN GENERAL AND OF SUN-BLOTCH

Some virus diseases may be transferred from one plant to another by mere contact (tobacco mosaic'); others by introducing sap from a diseased to a healthy plant; others by sucking insects (beet curly top); others are transferred only by an established union of living tissues, as of bud or scion (citrus psorosis). We have not succeeded in transmitting sun-blotch except by graft or bud unions which made permanent contacts. We have not been able to transmit it by contact of diseased with healthy foliage, by introducing sap from a diseased to a healthy plant, or by cuts with a knife or saw from diseased to healthy plants as might be done in pruning. For certain viruses it has been established that spread is very rapid after introduction into a plant, so that very soon the whole plant is invaded. In general, virus diseases have not been cured by application or treatment, such as spraying with chemicals, pruning, etc. The matter of insect carriers (called vectors) of sun-blotch has not been studied, but as in psorosis of citrus, if such transmission occurs it is not frequent.

Usually virus diseases are not transmitted in the seed, but there are a few exceptions (bean mosaic) and there are some doubtful cases where transmission may occur rarely. Sun-blotch is not usually carried in the seed but it would not be safe to say that this

never happens. In sowing seeds of any kind, we expect some seedlings to be defective, variegated and off-type. Some avocado seedlings are of these types, sometimes suggesting true sun-blotch. Cases that are evidently true sun-blotch sometimes appear where, so far as known, there has been no previous budding or other operation by which the disease might have been introduced, but usually the information about the trees is not complete, so that we do not know how the disease got into them.

As with citrus psorosis, we now believe that if we use scions and stocks free of the specific virus that the progeny will also be free of the virus. The greatest importance then attaches to the symptoms by which the disease may be recognized, in order that disease-free wood may be used for propagation.

SYMPTOMS

Primary Symptoms, those in Young Growths

On the Green Stems: The most frequently observed symptom is one or a few light-yellowish, depressed, longitudinal streaks. These are usually most prominent in the areas on the stem marked by numerous small buds which are the early parts of a flush of growth. In these areas the light streak may be broadened to entirely surround the stem. From these areas the light portion extends upward and narrows to the typical light streak. The light streak usually does not continue to the end of the flush of growth. Where leaves originate in the light-colored area, the petioles are lighter than normal and this light color may extend to the veins of the leaf. In some stems the streaks may be broken up into light spots which are irregular in shape, more or less vague in color, and not always clearly distinct from the condition of some pale stems which are not affected with sun-blotch. Very succulent, vigorous stems such as arise from severe cutting back or below stem girdles may have the streaks much depressed and the stems weak so that they bend over. Normal shoots, under similar conditions, may also be angular when young so that they might be mistaken for diseased stems. The light color in the streaks is the significant, distinguishing feature in this case.

On Green Fruit: Streaks similar to those on the stems are often shown on fruit. They are most pronounced from the stem end to the middle and are often so depressed that the fruit is much distorted. At and below the middle the streaks often occur as rather broad spots. In round or short fruits the streaks may take the form of broad depressed areas. When fruits of dark varieties attain color, the sun-blotch streaks remain lighter than the background color and show up strikingly as a rich red or royal purple.

Below the surface of the streak there is also a light streak in the flesh which apparently softens with other parts of the flesh. Although they are edible, sun-blotch streaked fruits become culls on the market. The percentage of affected fruits on sun-blotched trees is variable. Whether this varies from year to year has not been determined. On small trees with a few fruits, cases have been observed where all were streaked, but this is exceedingly rare. Sometimes no marked fruits are found on a tree which shows distinct symptoms on the twigs.

On the Leaves: Search has been made for a dependable constant symptom on young leaves comparable with the markings of citrus psorosis on young leaves, but without

success. On some varieties (Puebla, Caliente, and some seedlings) very variable and striking white areas may occur on some of the leaves. Where the abnormal area is large, the white part develops less than the green part so that the leaf is deformed. In other cases the abnormal part of the leaf is not white but gray-green and develops less than the normal green tissue. The normal part becomes much ruffled and distorted. In other cases there is a pale, vague spotting and mottling of the leaves. The leaf symptoms have not been observed on Fuerte. It may not always be possible to distinguish the chimeras and defective plants in the seedbed from those carrying sun-blotch virus, except by propagation experiments. When a chimera is grafted into a normal plant, the stock sprouts should be normal, whereas with sun-blotch, symptoms should also appear in the stock sprouts.

Secondary Symptoms, i.e., Those on Old Portions of the Tree

Rough Bark: Twigs, stems and trunks of severely, sun-blotched trees appear to age more rapidly than corresponding parts of normal trees. The corky, surface tissues of the bark become dry, brown and cracked at an earlier age than surfaces of normal trees. When the rough bark is cut into, brown streaks are found in the living part and usually to some extent in the wood. This symptom again suggests the condition found in citrus psorosis but the wood streaks are usually less abundant. Other conditions may also cause rough bark.

Decumbent Habit: Heavily affected sun-blotch twigs have a deficient development of their woody tissues. They are very frequently weak and bend down easily. This often gives rise to a striking change in habit or aspect of the tree so that it becomes sprawling, bushy and decumbent. Both the rough bark and the bushy habit furnish symptoms which are easily seen, but these conditions may have other causes also so that until other symptoms are found the affected trees should be considered as suspicious cases only.

Intensification of Symptoms: Treatments which stimulate the formation of a large number of new shoots in relation to the size of the trees often cause the development of intense symptoms of sun-blotch. By this means it is sometimes possible to show the existence of the disease when it was not apparent before. There are exceptions to this fact, however, since in some infected trees the resulting new growth appears to grow faster than the symptoms develop. Treatments which have these effects have been observed to be freezing back, dehorning and girdling.

APPARENT RECOVERY

Usually with virus diseases of plants it has been considered that if present, the virus was distributed throughout the plant, but exceptions occur. Plants with some virus diseases occasionally may appear to recover or cease to develop symptoms. It has been observed frequently that a tree intensely affected with sun-blotch may put up an apparently normal and vigorous shoot. Whether such shoots are actually free of the specific virus has not been fully determined. Also, if individual shoots may be free at first, how long they may remain so. When tested experimentally, a few such apparently normal shoots have appeared to be healthy, at least for a while, but most tests have

shown the presence of the disease. The concentration of the virus may be unequal in different parts of such vigorous shoots during periods of active growth. For practical purposes the presence of any sun-blotch symptoms in a tree must put the whole tree at least in the suspected class.

TRANSMISSION BY ROOT GRAFTS

As would be expected, evidence is at hand that sun-blotch virus exists in roots as well as stems. It has evidently been transmitted by artificial root grafting. It must be supposed that natural root grafting may sometimes occur, so that a tree very near to a tree with sun-blotch would be under some suspicion.

SUGGESTED PROCEDURE FOR CONTROL

Application to the Propagation of Nursery Trees and to Top-Working Older Trees

From the foregoing discussion it should be possible to develop a practical program for avoiding sun-blotch in new plantings or in top-working larger trees. It is obvious that prevention of the disease is the only sure method of control. Very careful and repeated inspection should be made of all mother trees from which scions or buds are to be taken. All trees which show any symptoms of sun-blotch should be rejected as sources of propagation material. This should result in a large proportion of healthy trees. Inspection of the trees, after planting or top-working trees known to be healthy, should give an additional check on possible errors in the selection of parent trees.

Selection of seed from healthy trees is advised as a protective measure. The seedbed, and also the young budded trees should be rogued severely in the nursery in order to remove weak, diseased, and non-typical trees. Such roguing should eliminate not only the abnormal and inferior trees but also cases of sun-blotch, if any should appear from unknown causes. Growers are advised to request their nurserymen to perform these operations conscientiously.

Top-working of larger trees is liable to give some trouble on account of the present inability to surely diagnose all cases of sun-blotch in old trees. Symptoms for diagnostic purposes can frequently be developed by girdling of large limbs in several parts of the tree. If sun-blotch is present, some of the new shoots developing below the girdle should show symptoms. A girdle of 1/4 inch should heal promptly, not cause appreciable harm to the limb and should cause the growth of numerous shoots below it.

Rather than to undertake grafting over even a slightly-affected sun-blotched tree it is probably better to replace it with a healthy tree. The grower may decide that replanting of a large number of affected trees be done gradually, by first replacing the most severely diseased trees with healthy ones.

Sun-blotch is often not strikingly injurious to the avocado tree. Frequently much of the growth in an affected tree may appear normal and the trees may produce reasonably good crops. We do not know what the future behavior of such trees may be. Perhaps they will behave as does citrus affected with psorosis, and decline in vigor and production at a later date. If used for propagation, they may become the parents of

badly diseased trees. Very probably it will be highly desirable to replace diseased trees with normal ones as fast as this can be done without undue loss.

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