

Aberrant Avocado Leaf Forms

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The normal avocado leaf is recognized as a broad, lanceolate structure with a distinct petiole and entire, smooth margin. Leaves of some selected cultivars may be slightly broader or perhaps narrower in comparison with leaves of other cultivars (2). Under some conditions, leaves growing in the shade on a tree may be broader and thinner in structure than leaves growing in full sun on the same tree. Most of the leaves on a given tree can be recognized as normal foliar structures. It should be noted that possible exceptions to this normal leaf form are frequently seen in leaves found at the base of a growth node. The growth node consists of several leaves formed along a shoot as the result of shoot extension. Flowering in the spring or other times when the inflorescence develops, is followed by shoot length growth. In this case, the first leaf to form is located in the basal position on the developing shoot. Subsequent leaves expand and mature in positions toward the growing apical point of the shoot. The first, or basal, leaf is often markedly reduced in size compared to the normal leaf, and sometimes actually appears as a bract. The basal leaf generally is smaller and frequently distinctly rounded, reniform, or kidney shaped compared to the normal, lanceolate leaf blade.

A rather unusual or aberrant leaf form is seen occasionally on avocado trees where the herbicide "Roundup®" has been applied to the soils near the drip of the tree, or possibly where drift vapors of the herbicide have settled on the foliage. The unusual foliage sometimes appears only on a single shoot or sometimes two or more shoots at random points of the tree will contain the aberrant leaves. The major disturbance of the leaf morphology is manifest as a nick or cleft at the tip of an otherwise entire leaf. On leaves more seriously affected, this cleft becomes deeper, resulting in the division of the apical portion of the leaf into two elongated tips to form a "rabbit ears" condition. The apical tips of the "rabbit ears" are frequently sharply pointed and may cross over in a scissors configuration. In the extreme case, the apical split or cleft becomes complete and results in the appearance of two apparently complete leaf blades supported by a single petiole. In the latter case, each blade exhibits the venation and marginal characters of the normal leaf.

"Rabbit ears" leaves have been noted as only a single leaf on a tree in some cases. In other instances, several aberrant leaves have appeared along the stem of a growth flush at various growing points on the tree. Not all growing points will develop the irregular leaf form. In fact, very few shoot tips show this unusual growth behavior on any given tree. There appears to be no deleterious effect on the tree as a whole, nor is there association with any aspect of irregular fruit development. The appearance of the "rabbit ears" leaves on some branches is unpredictable at present. These observations have been made on trees of the cultivars 'Hass' and 'Fuerte' in California, South Africa, and

Australia under various climatic conditions, but only where Roundup® had been used as a weed control at some time in the past history of the tree. Continued, and in some cases extensive, use of herbicides in and around avocado orchards appears to have little or no general negative effect on the normal morphological development of most of the leaves on the tree or its fruit. The occasional instances of modified leaf morphology in the avocado tree are described in this series of observations.

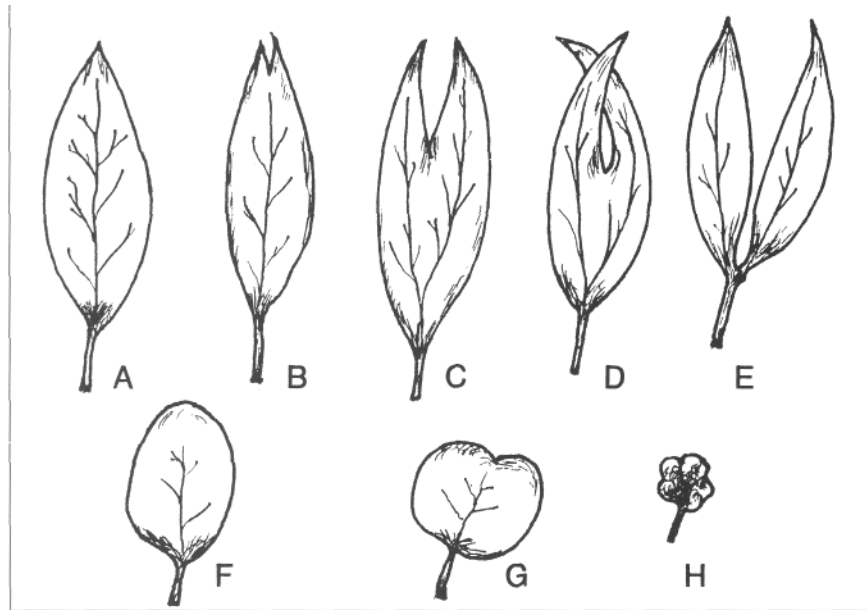


Figure 1. Normal and aberrant leaf forms in avocado. A - Normal leaf of avocado. B - leaf with small apical cleft. C - Leaf deeply incised at apex. D - Apex incised with tips overlapping. E - Leaf with two distinctive blades and a single petiole. F - Basal leaf of recent growth flush. G - Reniform basal leaf of recent growth flush. H - Callus-like distorted leaf on axis of seedling from immature avocado fruit.

Another type of avocado leaf distortions as the result of sun-blotch virus was at one time a common observation in some of our early orchard plantings (3). The sun-blotch effect generally was evidenced as a smaller leaf, crinkled on one side of the midrib which resulted in a scimitar-shaped blade associated with various degrees of internal tissue disorganization. The associated symptoms of stem streaking, irregular, and dwarfing growth of the tree, and extremely aberrant morphological manifestations on the fruit made the leaf symptom a warning signal of concern to the grower. Sun-blotch leaf symptoms are seldom seen in modern orchards except in occasional, very old trees which were propagated from unindexed sources.

Occasionally, observations have been made on the irregular leaf development associated with the germination of avocado seed where the first leaves of the seedling appear highly distorted and of very abnormal morphology (7). Instead of developing as a lanceolate structure, these leaves become highly crinkled, thickened masses of white callus-like tissue with no apparent internal organization. It was eventually discovered that such leaf tissue developed on seedling stems in instances where the seed had

been taken from immature fruit. If the fruit is mature when the seed is selected for germination, then a sequence of normal leaf development will proceed along the young seedling stem.

In the present study, the observation of aberrant leaf development as the result of application and the use of "Roundup®" as an herbicide is essentially circumstantial. Herbicidal "drift" in the process of application possibly accounts for some absorption of the herbicide directly on or very near the young developing leaf tissue. While "Roundup®" is claimed to decompose and become ineffective upon contact with the soil, there is some evidence that possibly small amounts of the active material can enter avocado roots and become transported to the tree canopy and enter the fruit (6) and perhaps other tissues of the tree top. Absorption of even small quantities of the active original ingredients by the developing tissues of the immature leaves in apical buds could account for the subsequent abnormal structure in the mature leaf. Breakdown products of the original herbicide ingredients also might result in hormonal factors which could induce abnormal tissue development in any growing points of plants.

Tissue aberrations associated with the use of glyphosate in other fruit species have been reported. Severe effects on leaf growth and on fruiting spurs and on sucker growth of raspberry and shedding of leaves in apple have been observed (i). Various modifications of plant tissue of peach trees including malformation of apical leaves (5) have been associated with the application of glyphosate directly on the plants. Some of these responses have resulted from application of the herbicide at very low concentrations.

It is of interest that the leaf forms of the sassafras (*Sassafras albidum* Nutt.) (3) is normally short lanceolate, but frequently is found to have leaf blades deeply incised almost to the trifoliate, or three-parted, condition. This extreme variation in leaf form of the botanical relative of the avocado apparently is normal and is not induced by applied growth hormone or other organic substances.

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