

Avocado Tree Root Development

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The avocado is naturally a surface rooting tree. The fine fibrous rootlets, which absorb water, food and air, develop in greatest abundance at or near the surface of the soil. Where mats of these fibrous feeders are permitted to develop normally near and at the surface, they function best when protected by a heavy undisturbed mulch of leaves and are kept reasonably moist. In its native or wild habitat in the Central American tropics frequent summer showers maintain an ideal condition of moisture in the leaf mold under the trees. In their early attempts to provide similar conditions, commercial avocado growers found that irrigation by sprinkling was especially agreeable to avocado trees as compared to other orchard crops.

Avocado tree roots are peculiar in that they require a lot of air or oxygen. When freely developing in the leaf mold under the tree, they have access to plenty of air and are most happy. When this mat of root fibers is partially shut off from the air by being covered with soil (especially heavy soil), the tree immediately shows its discomfort.

Partial loss of fiber roots when soil air is replaced by free water results in decline of the top, the degree or severity of which depends on the proportion of roots lost. Total and sudden loss of fibrous feeders results in collapse or asphyxiation.

While the above conclusion may now be considered as an established principle in avocado culture, there is little in it to satisfy the questioning of the average grower. Soils with ideal drainage are not common, in fact they are rather rare in California in locations where climatic conditions are most suitable for avocado culture. Those who are familiar with the history of the avocado industry in California know that from the beginning subdividers and planters generally looked first for suitable climatic conditions with available water, and considered soil conditions to be of secondary importance. As a result of this, many trees were planted on soils more or less unsuited to them. In fact, it is my opinion that the major part of the present acreage is defective in drainage and aeration. It is not surprising that there is a widespread complaint of tree decline.

It is quite beside the point to tell a grower that his tree decline is due to poor soil drainage when he has already spent his money planting trees on that soil. Of course, if he has planted in an impossible situation, the sooner he quits the better. But the great majority of growers are dealing with soils which are only partially defective. What the grower needs is a better understanding of the true soil conditions of his grove, as well as help in devising ways and means of so handling that soil as to overcome the difficulty or at least to avoid doing anything which will intensify the trouble.

There is no simple answer. Soil and subsoil conditions vary so widely in all districts that no plain rules can be applied. Sketches of different soil conditions drawn from my own observations illustrate the way avocado roots develop with respect to the presence or absence of air in the soil.

Figure 1 shows a very deep gravelly and well aerated alluvial soil as found on fairly level flood plains of San Gabriel and San Fernando valleys. On such soils a wide and deep root system is developed. The trees grow large and attain great age with little or no trouble from decline. Examples are the monster original Chapelow tree near Monrovia, the Bup orchard at Baldwin Park, the Fowler trees on San Gabriel Boulevard, and many large windbreaks of seedlings in the San Fernando valley. Any system of irrigation which wets the soil throughout the root area is generally satisfactory. Unfortunately, such well aerated soils are usually located where the frost hazard is a handicap.

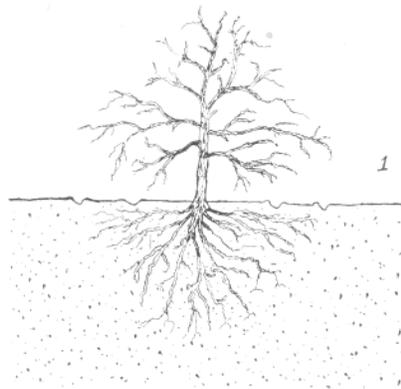
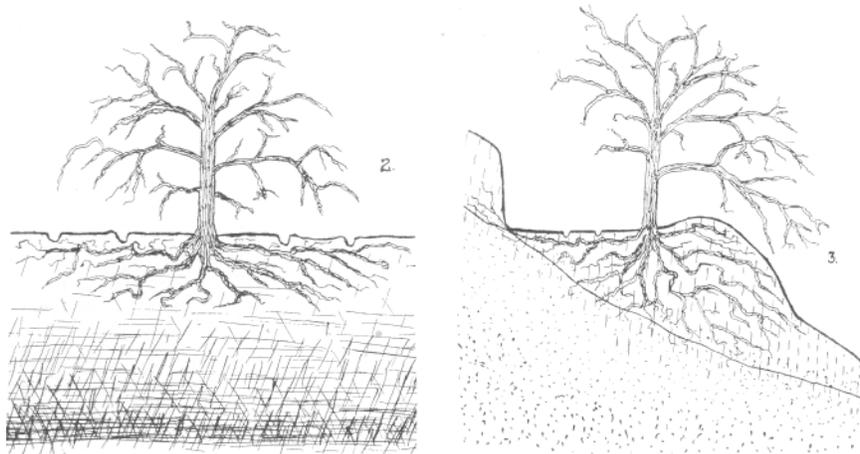


Figure 2 represents another type of level valley soil which is sandy on the surface, gradually increasing in density with depth. Here the root system is more shallow but widespread, and confines itself to the better aerated surface soil. Trees grow well and attain large size. Cultivation is not detrimental if practiced uniformly and regularly. If cultivation is stopped for a year, the root fibers come to the surface and are seriously injured by subsequent cultivation. Irrigation by either furrows or sprinklers should be given with caution, so as not to form a free water table above the dense subsoil and kill off a part of the root system. If this occurs either from too much irrigation or prolonged rainfall, the tree top will show decline. It may usually be cured by pruning back the top and withholding water until the soil has dried out sufficiently to again permit air to reach the roots.

In Figure 3 we have a typical terrace planting as is common in North Whittier Heights. The soil is old valley fill, subsequently elevated and eroded. Smooth, water-worn stones occur irregularly and there is usually not a well denned change from surface to subsoil. The soil mantle is deep on north and east slopes, and shallow on south-west slopes. Drainage and aeration are fairly good. If storm water is not allowed to stand on the terraces and irrigation carefully done, trees are healthy and seldom show decline. The roots are able to get plenty of air through the uncultivated banks below the terraces. Serious decline is caused where leaks in pipelines kill off the lower roots. When leaks are stopped, recovery is usually prompt. While the common method of irrigation is by

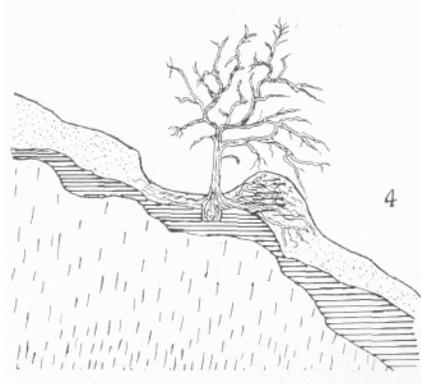
furrows, better results are had by low overhead sprinklers which permit wetting the outer bank where, on account of greater depth of top-soil, the best part of the root system has developed.



Under such conditions, cultivation is not necessary, but if Bermuda grass covers the terraces it will often hold back the run-off of storm water until the soil is saturated, the air driven out, and much of the root system killed. Decline caused in this way is often very difficult to cure because it occurs irregularly and irrigation must be very skillfully given or withheld according to the degree of decline of each individual tree. This is practically impossible with long-throw, overhead sprinklers, each of which covers several trees, both sick and healthy. It is necessary to substitute movable, low sprinklers on hose lines in the spots where decline appears in the orchard.

Figure 4 illustrates the distortion of the root system on granite slopes underlaid with variable and irregular layers of clay. Under such conditions trees are usually planted in basins on contours. Wet clay contains far too little air to permit root development, which is largely confined to the bank of top-soil on the lower side. Trees may be planted close together, as they do not grow large, but they tend to bear early and heavily, especially the Fuerte variety.

Where all of a tract of land is underlaid with clay it should not be planted to avocados. Usually most of a tract is good loam over disintegrated granite which is fairly well aerated. Trees decline only in spots where clay occurs. This situation calls for skillful as well as uniform irrigation year after year. Once the root system has accommodated itself to the obvious restrictions, a change in method of irrigation or the appropriation of the surface by Bermuda grass is almost sure to cause serious decline. All basins should be cut to prevent standing water during the rainy season. Bermuda grass should be rigorously kept out until the trees are large enough to shade most of the ground. The basins should not be allowed to fill with sediment washed in from a contour furrow. After one or two years of basin irrigation after planting, low sprinklers should be used to permit the roots to fill the shallow surface soil over wide areas in order to be able to support trees of at least moderate bearing size.



In conclusion, it must be emphasized that where avocados are grown in soil conditions shown in Figures 3 and 4, the grower should explore the subsoil and become familiar with the rooting habits in all parts of his orchard. He should remember that water standing temporarily "in" soil shuts out the air and is fatal to that part of the root system where such free water exists. Loss of part of the roots results in sickness and decline of the top proportionate to the amount of root fibers lost.