



Fig. 1. Seepage from surrounding hills in Ventura County caused rise in the water table and complete loss of this lemon grove.

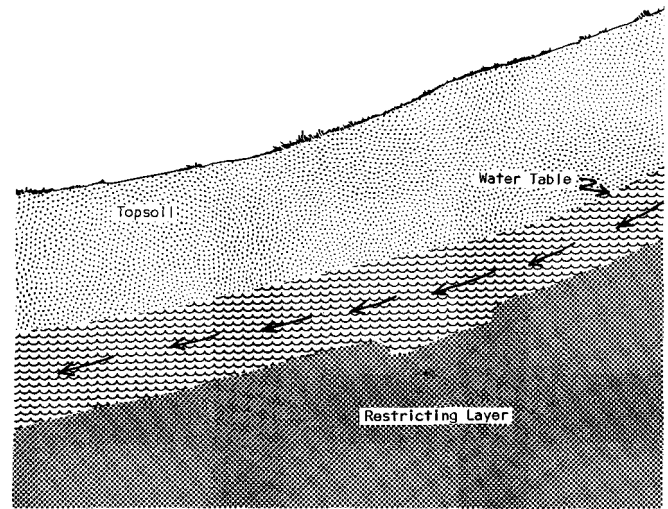


Fig. 2. Typical hillside seepage.

# CONTROL OF HILLSIDE in Avocado and

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Many of the citrus and avocado orchards near the foothills of Ventura and Orange counties are damaged by root disease and excessive wetness from hillside seepage. The damage is most severe during wet years or when the adjacent hills are excessively irrigated (see fig. 1). Dense subsoil and steep topographical conditions cause excess water from rain or irrigation to seep underground downslope creating a drainage problem (see fig. 2).

Investigation of soil conditions and the slope of the surrounding area should be made before orchard planting to ascertain the potential damage from hillside seepage. Once the extent of the seepage problem is determined, a properly designed drainage system must follow. The interceptor drain may be used to remove overland surface water or subsurface water seeping above a relatively impermeable soil layer. The seepage water may be intercepted near the top boundary. This procedure is normally followed in drainage engineering to intercept the water before it reaches the point where damage occurs.

Field investigations of existing orchards with drainage problems were conducted during 1964 to 1970 in several areas and revealed subsoil seepage. Wet

areas were monitored by installing observation wells. Three-inch diameter holes were augered as deep as possible, usually to an impervious layer. Gravel was placed in the bottom of the hole, then a pipe was inserted in the hole to prevent it from caving in. Such observation pipes should extend a foot or two above ground for convenience (see fig. 3). The pipes were installed in and surrounding the field areas. Topographical surveys were then made of the fields, and included elevations of the observation wells. The source, the direction, and fluctuation of the water table was obtained from these information sources.

## Drain installation

Once the location of the impervious layer and the position and direction of the seepage area were determined, drainage systems were installed. The water table auger holes were maintained to monitor the effectiveness of the drainage systems. In some areas, both interceptor and field drains were installed (see fig. 4). The interceptor drains prevent seepage water from entering the planted area (see fig. 5). The field drains are installed with-

in the orchard area to alleviate persistent water table conditions when all of the water from outside the field cannot be intercepted. The drainage tiles should be placed across the slopes as deeply as possible and immediately over the restricting layer. Slope is maintained in the tile line toward the collector drain. A grade of about 0.2 foot per 100 feet was found to be satisfactory. A gravel envelope of three- to four-inch thickness was used around the drains. Depending upon the local conditions, the drainage water may be collected in a gridiron or a herringbone system and discharged in a flood control channel or other outlet (see fig. 6).

## Size and spacing of tiles

Drainage designers usually recommend four-inch diameter field lateral lines if the length does not extend a quarter of a mile. With increasing length of the lateral, the size is increased every quarter mile. Six- and eight-inch tiles are usually large enough for main lines into which laterals discharge. These criteria are satisfactory for low, generally flat field drainage.

In San Juan Capistrano orchards and several Ventura County orchards, the

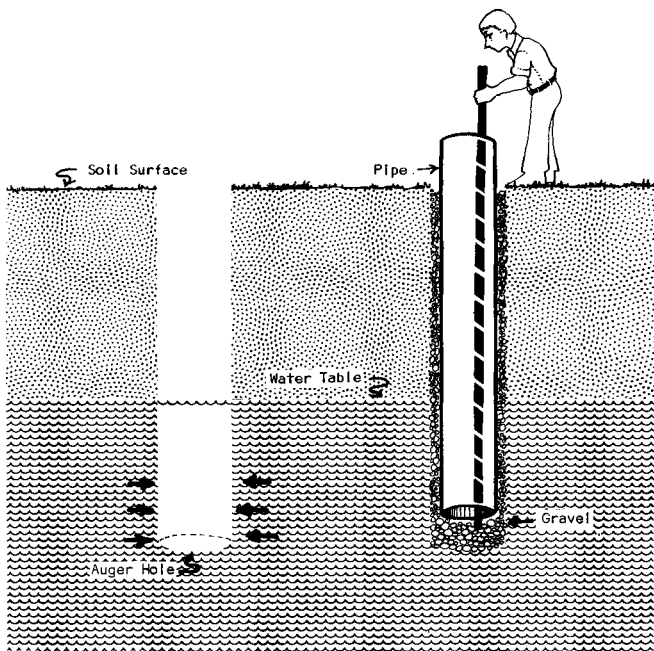


Fig. 3. Installation of observation wells.

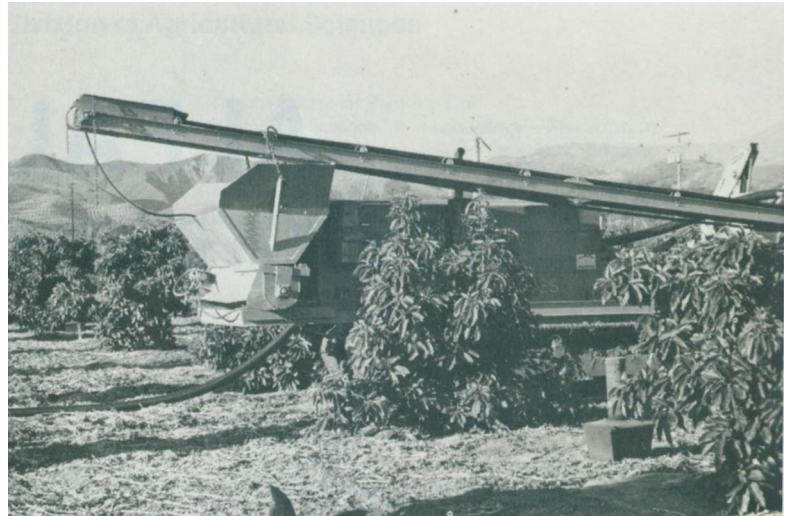


Fig. 4. Ventura County lemon orchard water table was lowered with 4" field drains installed every 100 feet five feet deep near the impervious layer.

# SEEPAGE Citrus Orchards

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Fig. 5. Water table receding after drainage installation.

interceptor drains were placed 100 feet apart. These interceptors were about 800 feet long and six inches in diameter. Ten-inch plastic collector drains were used to carry the water to flood control channels.

The tiles were slightly oversized to insure fast drainage when heavy storms occur. The water table receded to the restricting layer within 3 weeks after the system was installed.

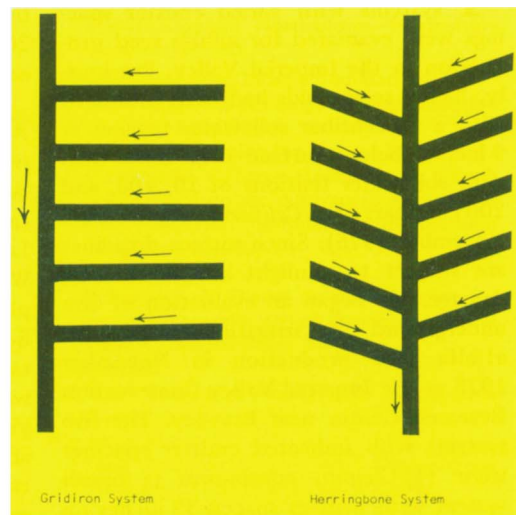


Fig. 6. Collection of drainage water.

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