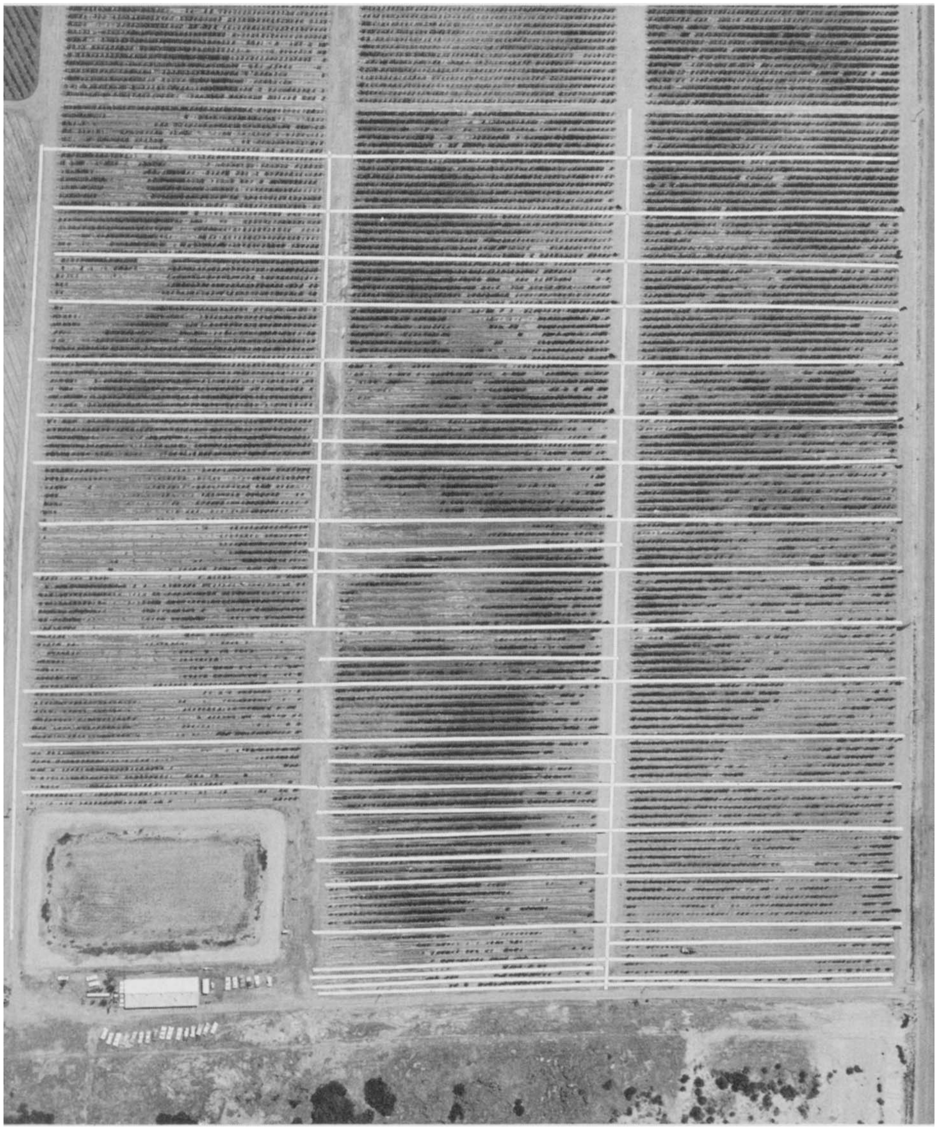


Aerial Photo of the test vineyard in March of 1963 at the start of reclamation. White lines show location of tile lines totalling 603 lineal feet per acre at a cost of around $600 per acre. Notice the location of the poor vines is not correlated with location of the drains.

# *Reclamation of a*

D. D. HALSEY · J. R. SPENCER
D. MULDER

A poorly drained Coachella Valley vineyard that suffered the loss of half its vines from salt damage has been reclaimed in six years by re-levelling the ground, changing the irrigation practices, and switching from the use of the highly saline Colorado River water to the use of a high-quality well water.

IN FEBRUARY 1963, a Coachella Valley Thompson Seedless grape ranch which was declining severely was selected for study because it appeared typical of a number of vineyards which were poorly drained despite installation of tile drains. Some leaf burn—indicative of salt damage—was visible, but it was not clear at that time whether vine decline was due entirely to salinity or to poor drainage or other faulty management practices.

## Early growth

The vines grew well after planting in 1959, had been trained up the stakes in normal time, and fruited in 1961. Irrigation in the early years was by conventional furrows using Colorado River water with an electrical conductivity of 1.3 millimhos. Wet spots began to appear in 1960 and tile drains were installed in November of that year. Vines began to die in spots in 1961. Death was preceded by a period of slower growth, burning of the older leaves and premature abscission.

As the first step in the study, the vineyard was plotted to show the condition of each vine in March, 1963. In each of the three blocks of the 40-acre vineyard, four locations of good vines, and four of bad vines were selected for study of the salinity status of the soil. It was apparent that the poor vines were in soils of higher salinity than were the good vines (table 1). An extensive piezometer network to study the water table showed that drainage was poor in spots despite the investment in tile drainage. However, there was no good correlation between the water table level and vine condition. Fine-textured soil, higher salinity and poor vines were associated, while sandy soil, lower salinity and better vines occurred together. These factors suggested there was insufficient water penetrating the fine-textured soil to keep it leached.

## Drain lines

An investigation into the drain lines showed a variety of conditions. A total of 603 lineal ft of drain line per acre was already installed. Some lines seemed to be functioning properly (in that the gravel around the pipe was not under pressure). In other lines cracks at the tile joints were plugged with sand, and in some cases the lines were filled with mud. The mud probably entered the lines after installation when the tile ditch was partially backfilled with soil, and irrigation water was applied to settle the soil. The water ran through voids in the backfill and directly into the tile lines carrying mud along with it. Most of these lines were successfully cleaned out by flushing with irrigation water. However, even above properly functioning

# COACHELLA VALLEY GRAPE RANCH

## *by changes in levelling, irrigation, and water source*

lines, there were spots where the fine textured soil layers interfered with normal drainage—causing the water to rise almost to the surface after irrigation, and to remain there for some time (while the tile lines produced very little water).

### Salinity

Having tentatively decided that salinity was the cause, efforts were made to leach the soil. The irrigation slope was reduced by dragging soil from the upper to the lower ends of the irrigation run. A French plow was used to remove the ridge from under the vine row. A levee down each middle allowed for ponding of the water close-up around the trunks, where it was held for many days until soil samples were reduced to below 3 millimhos at a depth of 3 ft. Irrigation has been by flooding since 1963.

Greater efficiency of irrigation was achieved by filling the individual ponds rapidly, avoiding the use of many small streams of water in furrows, and applying the water slowly over many hours in order to avoid runoff at the row ends. Greater use of the well has reduced the necessity for night irrigation, which is usually less efficient. When river water is used it must be accepted for a 24-hour period, making night irrigation essential unless a reservoir is available.

Scheduling of irrigations was also changed. The first reaction to the appearance of the salt damage had been to increase the frequency of irrigation. The effect was to keep the water table high without reducing the salt level in the soil. A program of prolonged leaching was substituted during the fall, when necessary traffic through the vineyard was at a minimum. Water was applied only as required for irrigation during the growing season.

Better quality irrigation water (table 2) was obtained by drilling a well which produced a flow of 1.3 second ft (usually sufficient to irrigate the 80 acres of this vineyard). Colorado River water was used during the autumn leaching operation. Since the well water is available by simply turning on a switch, there was no necessity to store water. An unlined reservoir formerly in use on the high corner of the vineyard was eliminated and was planted to vineyard—also contributing to lowering the water table.

### Leaching

The immediate effect of these measures was to reduce the salt level in the soil. Leaching was effective even though the water table was very near the soil surface while the water was being applied. The highest rate of flow achieved from the drain lines was 12.4 gallons per minute per thousand ft of drain. At peak flow, the average water table as measured in 45 piezometers was 1.5 ft below the soil surface. When the same piezometers were measured three months after the last irrigation the average water table was 5 ft below the surface and the flow from the tile lines levelled off at around 3.1 gallons per minute per thousand ft of drain. There was obviously a substantial sub-surface flow into this

TABLE 1. CHANGE IN SALINITY STATUS OF SELECTED VINEYARD SITES IN MAY 1963 (BEFORE RECLAMATION), IN OCTOBER OF 69 (END OF GROWING SEASON) AND NOV. 69 (JUST AFTER ANNUAL LEACHING)

| Vine Condition May 63 | Salinity Status of Soil (Conductivity of Saturation Extract) | | |
|---|---|---|---|
| | May 63 (Before reclamation) | Oct. 69 (End growing season) | Nov. 69 (After annual leaching)* |
| | millimhos | millimhos | millimhos |
| All good | 4.1 | 1.6 | .6 |
| All bad | 12.1 | 4.9 | 1.6 |
| Mixed good & bad | 6.8 | 2.6 | 1.2 |
| Mean of all locations | 7.3 | 2.9 | 1.1 |

* Leaching involved covering the ground with well water for four full days.

TABLE 2. COMPARISON OF QUALITY OF COLORADO RIVER WATER WITH THAT OF WELL WATER ON THE TEST VINEYARD

| Water source | Conductivity | Sodium | Sodium adsorption | Tons salt |
|---|---|---|---|---|
| | Millimhos | % | Ratio | Acre foot |
| Colorado River | 1.38 | 47 | 3.5 | 1.26 |
| Test vineyard well | .28 | 87 | 5.8 | .23 |

TABLE 3. PER CENT OF VINES BY CONDITION, BEFORE AND AFTER RECLAMATION

| | Good condition | Fair condition | No crop |
|---|---|---|---|
| | % | % | % |
| Before reclamation (March 1963) | 54 | 20 | 26 |
| After reclamation (March 1969) | 87 | 8 | 5* |

* Includes 486 vines (3%) removed and not replanted.

TABLE 4. IRRIGATION WATER AND SALT APPLIED IN WATER BY YEARS

| | Canal water | Well water | Total | Salt applied |
|---|---|---|---|---|
| | Acre ft/acre/year of water applied | | | tons/acre/year |
| Average 1959 to 1962 (Planting to reclamation) | 4.3′ | .2′ | 4.5′ | 5.5 |
| Average 1963 to 1969 (During reclamation) | 1.2 | 3.9 | 5.1 | 2.4 |

vineyard from irrigated lands up the slope.

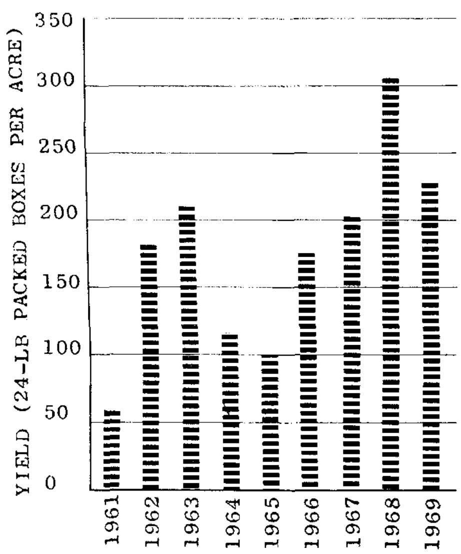
After salinity levels were reduced, and normal irrigation was resumed, vine condition slowly improved and it became possible to get replants to grow in those areas where the vines had died. The leaves no longer burn in the autumn, and in most areas there is no premature abscission of leaves (table 3). The yields have surpassed those achieved before the salt damage occurred (see graph).

### Summary

In summary, the procedures believed to have brought about reclamation of this vineyard are: (1) leaching of salts by reducing the irrigation slope, flooding the water over the root zone and holding it there until the salts were washed below the root zone or into the tile lines; (2) switching from high salinity Colorado River water to well water of much better quality; (3) eliminating a leaky reservoir which contributed to the drainage problem; (4) achieving greater irrigation efficiency by avoiding night irrigation and applying the water more rapidly; and (5) reducing the frequency of irrigation during the growing season —but adding a very heavy leaching irrigation in the fall when vineyard traffic was at a minimum.

*Dean D. Halsey is Farm Advisor, Riverside County; James R. Spencer is a Water Resource Analyst and Daantje Mulder is a Research Technician, both with the Coachella Valley County Water District.*

YIELD HISTORY, THOMPSON SEEDLESS DRAINAGE TEST VINEYARD
(Planted in 1959)




DEAN D. HALSEY

# *Construction and* OBSERVATION *is critical in* TILE DRAIN

Studies reported in the accompanying article of possible causes of poor drainage (despite tile line installations), have also shown that great care must be taken in the construction and location of observation wells used to measure the water table. Open auger holes may be useful to the farmer in determining the water table at one specific time, but are not satisfactory for repeated measurements, especially in unstable soil. Perforated and wrapped plastic wells are desirable for this purpose. For determining the causes of drain failure, however, a wrapped piezometer is recommended because pressures must be determined at specific points. This article discusses the proper construction and placement of observation wells.

AUGER HOLES (over the top of the drain) have been used to study the apparent failure of tile lines to drain soil properly in the Coachella Valley. Two disadvantages of this system include: (1) surface water, soil, and animals can fall into them. Therefore the auger holes can be relied upon only immediately after they are drilled; and (2) as the water table rises, mud can flow into the hole which then must be cleaned before measuring while the water table is falling.

Black iron pipes have also been used for piezometers. These have been jetted or driven into the desired location. The pipes effectively prevent water or debris from falling in from the surface, but they do not stop the flow of mud from beneath, and they are more difficult to clean than auger holes in some locations.

### Fiberglass

Recently, 1-inch plastic pipe wrapped with fiberglass was used. The fiberglass is about ½-inch thick and has a moisture-resistant binder which meets the specifications of the Agricultural Conservation Program for use as a filter around drain lines. In some cases perforations have been made in the sides of the pipe. In others only the hole in the end is left open. The fiberglass wrapping effectively prevents the flow of mud into the pipe while allowing for free flow of water in and out of the well. Some of these have been in use for a number of years without failure.

In some cases, however, there have been substantial differences in apparent water table readings from wells in close proximity and presumably sampling similar conditions. To determine the cause of such variation, six different types of wells were installed over each of two adjacent tile lines at a vineyard location where troubling differences had been observed. The tile lines at this location produced very little water while the water table was often near the ground surface during, and for some time after, a heavy irrigation. The soil was classified as Indio very fine sandy loam in the surface