Vineyard irrigation in the Salinas Valley

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The Salinas Valley shows promise of becoming a distinctive new region for growing premium wine grapes. To make the most of the cool and windy climate, however, particular irrigation management practices are required. Irrigation itself is a necessity, because annual rainfall is much lower than in the nonirrigated vineyard areas north of the San Francisco Bay, and because root depths are characteristically shallow—most of the vineyards are on old terrace soils with shallow restricting layers in the form of clay pans or abrupt stratified zones. In previous tests, we have shown that nonirrigated or minimally irrigated grapes on shallow soils in Salinas Valley are very deficient in both yield and quality compared to carefully irrigated vines.

The challenge, then, is to manage irrigation so as to (1) fill but not overfill the trellis with vegetative growth, (2) slow or stop vigorous shoot growth early enough to channel photosynthate into the developing clusters, (3) avoid early defoliation to build up vine reserves and mature wood, and (4) if necessary, leach accumulated salts from tight subsoils during the dormant season. Accomplishing all of this within the climatic framework and soil limitations requires skillful management of the frequency of irrigation and the quantity of water applied per irrigation.

It is very important that the grower know the depth of the potential root zone and its available water-holding capacity. The depth can be determined most readily by digging backhoe pits to see how deeply the vine roots go. Roots will grow very deeply if soil moisture, air, and porosity are favorable. The available water-holding capacity per foot of depth may be estimated from the soil texture, as shown in the table.

A 2-foot-deep loam soil will have a total available water-holding capacity of 3 to 4 inches. If an irrigation is applied when not more than half of the available water has been used, no more than 1½ to 2 inches should be applied in that irrigation. Any more than that will probably cause a perched water table and poor aeration in the root zone. A tensiometer installed just above the restricing layer is a good way to determine whether the quantity of water applied is adequate or excessive. If it is adequate, the tensiometer gauge should move down to around 10 centibars within a day or two after the irrigation and should gradually move back upward. If the gauge stays below 10 centibars for several days, the irrigation was excessive.

To determine frequency of irrigation, a second tensiometer should be placed midway between the restricting layer and the soil surface, but not less than 12 inches deep. The readings on both tensiometers are then monitored and used to estimate when the next irrigation should be scheduled. Tensiometer reading criteria will change during the season as the shift from vegetative growth to fruit maturation and reserve storage progresses.

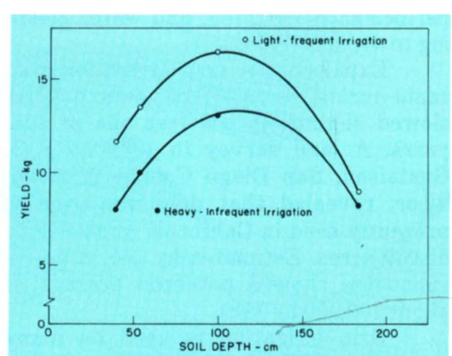
Although this procedure works well if the soil depth is relatively uniform throughout a vineyard, in many Salinas Valley vineyards soil depth is quite variable, even within sprinkler-irrigated blocks. To determine what kind of compromise in irrigation quantity and frequency would best suit mixed deep and shallow soils, an experiment was conducted from 1971 to 1975 in a typical Salinas Valley vineyard. The root zone was limited to the loam soil overlying a coarse sand that varied in depth from 14 to more than 84 inches below the surface. Two irrigation treatments (HI = heavy, infrequent—based on a calendar schedule; LF = light, frequent—based on soil moisture readings by tensiometers) were replicated three times on soils of four average depths (16, 21, 40, and 72 inches) within one block of Chardonnay grapes.

There was a highly significant quadratic relationship between the yield and the soil depth categories for each irrigation treatment (see graph). The LF irrigation, which was designed specifically to prevent excessive water in the shallow soils, gave better yields in the intermediate and deep soils. Also the quality of the grapes, as judged by °Brix,

An abrupt bluff separates old alluvial terraces from the recent Salinas River floodplain. The terrace soils have shallow clay layers; the floodplain soils are often stratified. New vineyards have been planted on both kinds of soil.

Available Water-holding Capacities of Various Soil Textures

Soil texture class	Available water-holding capacity per foot soil depth
	inches
Sand loamy sand	5-1 0
Sandy loam	1 0 1 5
Loam silt loam clay	1 5 2 0
Clay loam silty clay loam	2 0-2 3



Light-frequent irrigations produced higher grape yields than heavy-infrequent irrigations at all soil depths. Soils of intermediate depth provided optimum balance between vine growth and fruit production, and outyielded shallower or deeper soils.

pH, and total acidity, was as good or better for the LF irrigation treatment as for the HI treatment.

In each irrigation treatment, the maximum yield occurred in the moderately deep soils, where a favorable balance between vine growth and fruit production was most easily attained. The low yields on the very deep soils were attributed to the inability to control excessive midseason vegetative growth. Such growth competed for photosynthates throughout the late summer and resulted in lowered carbohydrate reserves and reduced vigor the following spring. This, in turn, produced low cluster count and poor berry set.

If the soil depth had been uniform across the vineyard for any one of the four depth categories, it would have been much easier to manage irrigations for optimum yield and quality for the entire block. For this reason, growers are advised to plan vineyard blocks and sprinkler irrigation systems to conform as nearly as possible to soil blocks that are uniform in depth and texture. However, even soils with considerable variability can produce better crops if the grower frequently monitors the soil moisture status and schedules irrigation quantity and frequency to maintain soil moisture at desired levels. These levels will vary, depending on the stage of vine growth and crop maturity.

Careful irrigation not only can improve yield and quality, but may also cut down costs. In our experiment, the light, frequent irrigation treatment used significantly less water than did the heavy, infrequent irrigation. In some years the water saving was almost half. In addition, pruning costs were less for the LF treatment, because it reduced excessive vine growth on the deeper soils.

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Drainage problems in the San Joaquin Valley—an interagency approach

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The west side of the San Joaquin Valley between Tracy and the Tehachapi Mountains has developed or will develop drainage problems. Ultimately, about 1½ million acres will be affected. Agricultural production could be reduced up to 80 percent in the most seriously affected areas.

The drainage problems are a result of the buildup of perched ground water. Clay layers in the soil and clayey-type soils severely restrict deep percolation in the valley trough. Because of minerals in the soils and in the perched ground waters, it is necessary to maintain salt balance in the root zone by leaching. As the west side has developed firm agricultural water supplies, and irrigation is practiced annually rather than intermittently, the water used for leaching builds up on the restraining soil layers.

This perched ground water usually enters the root zone sometime between 5 and 50 years after annual irrigation is established. Encroachment into the root zone will reduce crop yields. The effect can be so severe in some areas that lands will go out of production unless tile drains are installed to maintain the perched ground waters below the root zone. The waters collected in the tile drains are not usable as agricultural supply water because of their high salt content—5,000 to 10,000 mg/l total dissolved solids (TDS). In some cases, the salt content is so high (40,000 to 80,000 mg/l TDS) that it cannot even be blended to make an acceptable supply water. It is the safe handling and disposal of the salts in the drainage rather than the water itself that is the problem.

Eventually about 600,000 acre-feet per year of this high-salt drainage water will be produced. Most of it will be generated south of Gustine, and about 60 percent of it will be produced during the irrigation season from April through August.

Local areas are developing solutions to the drainage problems that now exist. Areas north of Patterson discharge to the San Joaquin River. A drain being constructed to serve the San Luis service area is authorized to be completed to the western Delta. The Tulare Lake area is constructing evaporation ponds. Kern County is investigating the use of drain water for power-plant cooling. These local solutions, with the exception of San Luis Drain, are not ultimate solutions, because they either discharge salts to surface water or maintain the salts in the valley.

The San Joaquin Valley Interagency Drainage Program (IDP) was established in 1975 to develop a program leading to an ultimate solution. The Interagency Drainage Program is sponsored by the U.S. Bureau of Reclamation (USBR), the California State Water Resources Control Board (SWRCB) and the California Department of Water Resources (DWR). It is a three-year program to be completed in 1978. Its objectives include maintaining irrigated agriculture at its present level and preventing adverse ef-

Barley affected by drainage problems. In the foreground, salt has formed on the soil surface.