Major financial institutions such as Prudential Insurance, Bank of America, Crocker National Corporation, Wells Fargo Bank, and First Interstate Bank gave a total of about $149,000 to defeat the water resources initiative. Utilities, including Pacific Gas and Electric, Pacific Lighting Corporation, Southern California Edison, and the California Water Association, provided an additional $95,500 to oppose the measure.

Safeway, Del Monte, Carnation, Coca Cola, and 7-Up were among members of the food industry that worked against the water resources initiative. Raising over $94,000, processors seemed more concerned about the negative impact this measure might have on their industry than they had been interested in the benefits they might have derived from additional water sent south through the Peripheral Canal.

The entertainment sector was much more important in the water resources campaign than in the canal campaign, primarily because of contributions from a wide variety of businesses that depend on rafting, fishing, and other outdoor sports. These proved to be the only businesses that aligned themselves with environmental groups in support of the water resources initiative.

The entertainment groups opposing the conservation initiative were of an entirely different nature. They included the Hilton Hotels Corporation and country clubs such as the Ironwood Country Club, Los Angeles Turf Club, Oak Tree Racing Association, and the Los Angeles Athletic Club.

Seven of the ten major interest groupings examined supported the Peripheral Canal initiative. In contrast, the agricultural sector and environmental associations were decisive factors in the defeat of the Peripheral Canal referendum through the grass-roots campaigning of environmentalists and big campaign contributions from large agribusiness.

Of the seven that supported the Peripheral Canal initiative, only four (oil, utilities, food processing, and retail) played a significant role in working to defeat the water resources initiative, although the financial sector also united in working against this initiative. Environmental associations increased their campaign contributions almost five-fold in support of the water resources initiative over the relatively small amount of $23,000 they spent in the campaign against the Peripheral Canal. However, these associations proved no match for a united agricultural sector, which outspent them at a ratio of almost ten to one.

There are two lessons to be learned from the study of these recent political battles over water. First, no single, monolithic group controls the development of water policy in California. While some powerful interests such as oil and utilities remained united on the same side in each election, others became substantially less or more involved depending on what was at stake for them. Agriculture and conservation proved the two interests that split most radically between the two elections.

Second, this study suggests that the coalition most likely to win in a political conflict over water will be the one that is able and willing to spend the most money on the campaign, regardless of the number of donors involved. In the water resources campaign there were many more small donors supporting the referendum than opposing it. However, the superior ability of the opposition to finance a campaign against it assured the defeat of this initiative.

In the Peripheral Canal campaign 40.9 percent, and in the water resource campaign 51.6 percent of the total contributions came from sectors of the economy other than agriculture or food processing. As water becomes a more critical factor for their development, it is likely that these sectors will be willing to spend increasingly greater amounts of money to protect their own interests in the exploitation of this vital resource.

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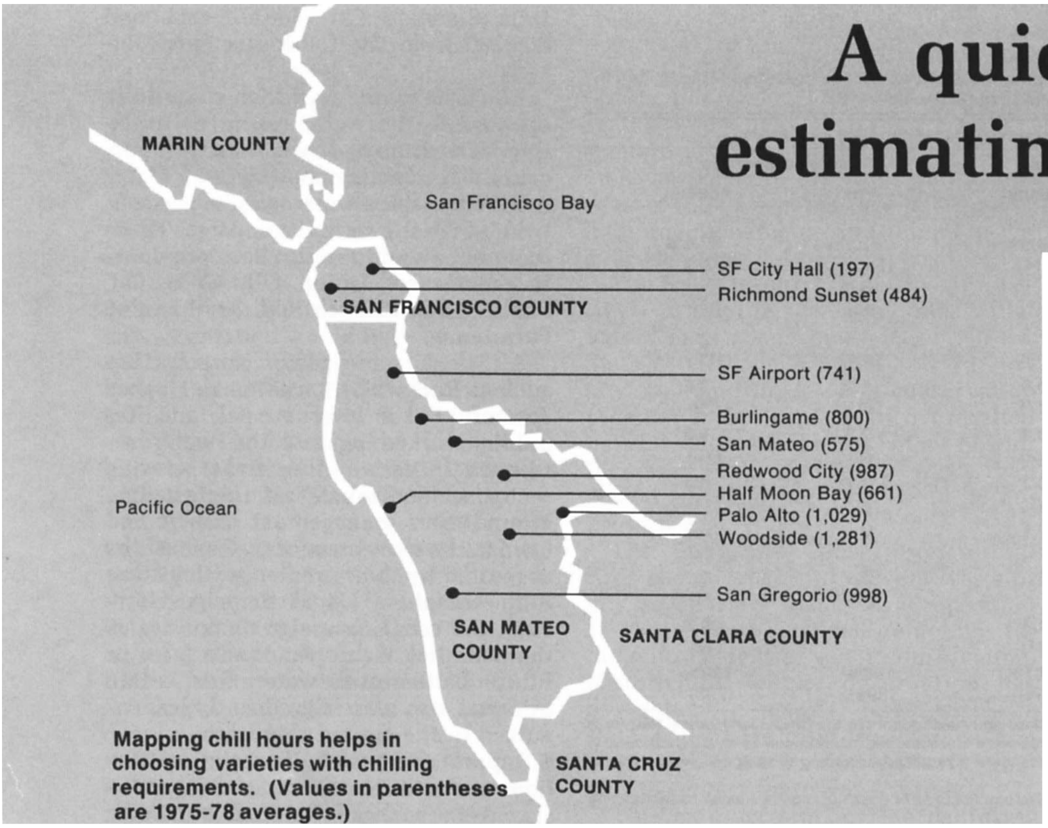
A quick method of estimating chill hours

Laurence R. Costello



Mapping chill hours helps in choosing varieties with chilling requirements. (Values in parentheses are 1975-78 averages.)

Most deciduous fruit and nut trees require a period of cold temperature below 45°F during the winter to induce dormancy and promote satisfactory fruit and shoot development in the spring. The length of cold period required, or chill requirement, has been established for most commercial fruit and nut varieties; values vary considerably among species. For example, most apple varieties require more than 1,000 chill hours; almonds generally need only 200 to 500.

Chill hours can be measured continuously throughout the day with a thermograph, which records air temperature, or with a hygrothermograph, which records temperature and relative humidity. The number of hours the temperature remains below 45°F can be read directly from a thermograph, and chill hours can be totaled for a desired period of time. Since chilling temperatures vary with location and from year to year, several sites are usually monitored and readings are made over three to five years to obtain a reliable average.

The need for time and equipment to make these measurements has precluded the development of chill-hour data for many areas of California. Unless a site has a history of fruit-growing, chill-hour information is unlikely to be available. Estimates based on observation rather than measurement are not reliable. As a result, an alternative method was needed for estimating chill hours in locations not previously studied. It was suggested that daily maximum and minimum temperatures might be statistically correlated with chill hours. If such a relationship were found, then chill-hour data could be developed for any area where temperature figures are available.

A review of the literature showed that R.H. Aron (PhD thesis, Oregon State University) had developed a good statistical correlation (r=0.979) between maximum and minimum temperatures using the following equation:

Chill hours below 45°F = $801 + 0.2523B + 7.57B^2 \times 10^{-4} - 6.51 \times 10^{-10} - 11.44T_1$

T_1 = average minimum temperature (°F)

T_2 = average maximum temperature (°F)

$B = \frac{7.2 - T_1}{T_2 - T_1} \times HD$

H = 24(hrs/day)

D = period in days (usually one month)

Aron used the equation to estimate chill hours for several locations in California. Since actual thermograph chill-hour values were not presented, however, the accuracy of calculated values was tested with thermograph data for two coastal locations and two inland locations in California.

Methods

Thermograph charts were collected for November through February for either three or four years in four locations (table 1). The actual number of hours that temperatures remained below 45°F were read from the charts and totaled for each year. These values were considered to be the actual chill hours at each station. Daily maximum and minimum temperatures were then read from the same thermographs for the same years that actual values had been determined. These daily temperature values were used in the Aron equation to calculate the estimated chill hours by means of a computer. Estimated chill-hour values presented in table 1 are based on average monthly minimum and maximum temperatures.

Results

There was a highly significant correlation between actual and estimated values for the two inland sites (Davis and Blackwell's Corner). During years when actual values were greater than 1,000 hours, estimated values were within 10 percent of actual values. Greatest differences occurred during years when chilling was relatively low — less than 1,000 hours. Estimates in those years were between 12 and 18 percent of actual. Comparing three- or four-year average values, estimates were 2.2 percent less than actual values at Davis, and 8.2 percent less at Blackwell's Corner. For these two locations, therefore, the equation appears to give a reasonably good estimate of chill hours received for the years tested.

The coastal locations of Santa Maria and Watsonville averaged 641 and 653 chill hours per year, respectively, in 1979-82. Chill-hour estimates from the equation for the same three-year period were an average 21 and 24 percent below actual values. Even though analysis showed a significant correlation (between 1 and 5 percent levels of significance) to exist between estimated and actual values, each estimate was consistently lower than the corresponding actual value. This suggests that a correction factor may need to be included in the equation for it to be useful in coastal areas. As is, the equation does not appear to be a reliable method for estimating chill hours in coastal areas.

It is possible, however, that chill-hour estimates (from the equation) for coastal areas could be used to assess relative differences or similarities between particular sites. For example, estimates for Santa Maria and Watsonville show that both sites are roughly similar in number of chill hours received and that both receive relatively few chill-hours. In this case, the equation gives an indication that chill-hour deficiencies may occur at both sites and varieties with high chill requirements should be avoided. One would use these relative differences or similarities merely as chill indicators, however, and could not rely on them as on actual values.

Chill-hour map

This method was used to calculate chill hours for San Mateo and San Francisco counties. The climate within these

TABLE 1. Actual and estimated chill-hour values for four California locations*

Location	Year	Chill hours Actual	Chill hours Estimated	Coefficient of correlation (r)†
Davis (Yolo County)	1969-70	1,022	1,127	
	1970-71	1,618	1,461	
	1971-72	1,837	1,798	
Average (3 yr)		1,492	1,462	
Blackwell's Corner	1976-77	1,305	1,173	
(Kern County)	1977-78	773	632	
	1978-79	1,403	1,426	
	1979-80	971	850	
Average (4 yr)		1,113	1,021	0.968
Santa Maria (San Luis	1979-80	801	691	
Obispo County)	1980-81	623	460	
	1981-82	500	387	
Average (3 yr)		641	512	
Watsonville	1979-80	467	309	
(Santa Cruz County)	1980-81	861	659	
	1981-82	631	532	
Average (3 yr)		653	500	0.875

* Actual values were taken from hygrothermograph data, and estimated values were calculated from maximum and minimum temperatures using the Aron equation.

† Coefficient of correlation (r) was calculated for the combined data (7 years) of the two inland sites (Davis, Blackwell's Corner) and for the combined data (6 years) of the two coastal sites (Santa Maria, Watsonville).

TABLE 2. Estimates of chill hours for 10 locations in San Mateo and San Francisco counties*

Location	Estimated chill hours† 1975-76	Estimated chill hours† 1976-77	Estimated chill hours† 1977-78	Average (3 yr)
San Mateo County				
Burlingame	769	832	—	800
Half Moon Bay	750	417	818	661
Palo Alto	990	797	1,301	1,029
Redwood City	1,034	864	1,064	987
San Gregorio	1,047	809	1,138	998
San Mateo	661	490	—	575
San Francisco Airport	751	629	845	741
Woodside	1,197	1,244	1,403	1,281
San Francisco County				
City Hall	150	—	244	197
Richmond-Sunset District	485	453	516	484

* Estimates were calculated from daily maximum and minimum temperatures for each location using the Aron equation.

† — = temperature data incomplete or not available.

two counties is quite diverse, consisting of a cool coastal zone, a warm southern zone, and a mild midpeninsula zone. Data for 10 locations throughout the two counties during November through February 1975-78 were processed using daily maximum and minimum temperatures obtained from National Oceanic and Atmospheric Administration Climatology Reports. Results show a large range in chill-hour estimates, from 150 hours in San Francisco in 1975-76 to 1,403 in Woodside in 1977-78 (table 2).

The chill-hour map constructed from these values shows that chilling is greatest in the hot-summer/cool-winter, south peninsula zone (approximately 900 to 1,200 hours). The cool-summer/mild-winter coastal zone had the lowest number of chill hours (200 to 600), while the midpeninsula zone had an intermediate number of chill hours (600 to 800). Both the midpeninsula and south peninsula zones can be considered climatically closer to the inland locations of Davis and Blackwell's Corner than to the coastal sites of Santa Maria and Watsonville. Therefore, the values calculated using the Aron equation should be a reliable indication of actual chill hours received. However, values calculated for the coastal zone may not closely reflect the amount of chilling received: they are likely to be somewhat less than actual values. These estimates are an indication, nonetheless, that chilling hours in this coast zone are probably not sufficient to meet the requirements of high-chill fruit species.

The estimated value for the city of San Mateo also appears low in comparison with Burlingame and Redwood City. However, since the thermograph for San Mateo was adjacent to a wall, heat from the wall may have increased night temperatures and resulted in the low chill-hour estimate. A more likely value for San Mateo is suggested to be between 800 and 900 hours.

In conclusion, this equation offers a quick, economical means of estimating chill hours for inland areas, and can be used to construct a chill-hour map. Such a map can be useful when evaluating an area for either commercial or home fruit, nut, and berry production. Varieties can be selected for areas in which they will receive adequate chilling, and those with high-chill requirements can be avoided in zones with low chilling.

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Previously imported parasite may control invading whitefly

Mike Rose ☐ James B. Woolley

During urban grid surveys in September 1982, San Diego County biologists discovered a new invading whitefly on avocado. Ray Gill, insect taxonomist for the California Department of Food and Agriculture (CDFA), identified the new invader as *Tetraleurodes* sp. Steve Nakahara of the United States National Museum then confirmed both the identification and the fact that the whitefly was new to California. Gill and Nakahara agree that this whitefly is the same undescribed species known from the Caribbean, Central America, Florida, and Mexico.

The whitefly

The adults of both sexes of the invading *Tetraleurodes* sp. bear red wing patterns, prompting the common name, red-banded whitefly.

Wing patterns of adult give red-banded whitefly its common name. Also shown here is black fourth-stage larva.

Adult female *Cales noacki* wasp parasitizes both red-banded and woolly whitefly.

Several other species of *Tetraleurodes* are found in southern California, including the mulberry whitefly, *T. mori* (Quaintance), acacia whitefly, *T. acaciae* (Quaintance), and Stanford whitefly, *T. stanfordi* (Bemis). The red-banded whitefly can be distinguished from these three species in southern California by both adult and larval characters. The red patterns on the wings are unique to the red-banded whitefly and are readily visible. Late larval stages of all four species are a characteristic jet black, surrounded by a white marginal fringe. However, red-banded whitefly larvae, which develop on the undersides of maturing avocado leaves, produce a copious white marginal fringe that curls up and partially covers the dorsum. The white fringe of mulberry, acacia, and Stanford whitefly larvae generally lies flat on the leaf surface and is not as prominent.

Additionally, of the three named species of *Tetraleurodes* previously in southern California, only mulberry whitefly has been recorded from avocado. Therefore, host plant association is a partially reliable means of identifying the red-banded whitefly.

History

Following the original detections in San Diego, we were asked to examine the newly discovered infestations. A preliminary search indicated that the red-banded whitefly infestation was more widespread than had been known. A subsequent survey of avocado trees by the County Department of Agriculture showed some 100 square miles infested in southern San Diego County.

The extent of infestation in California and plant host range are as yet unknown. The California Department of Food and Agriculture has determined that eradication programs against other whitefly species have generally failed. Thus, attaining biological control is critical, particularly because avocado growers rely extensively or completely