Some Effects of Overcropping on Wine Quality

1. Lower °Brix
2. Lower pH
3. Lower color
4. Lower nitrogenous fraction
5. Less aroma
6. Less taste

There is a linear increase in quality of Lodi Zinfandel cropped at 11 to 6.5 tons/acre in 1974.

Both aroma and taste intensity are greater with less crop.

Because of certain adverse effects of the gibberellin treatment, we cannot extend our range of data to include the 5.1 tons/acre treatment. Discounting the effect of gibberellin, the data tend to indicate superior wines could be produced at this level.

Quality of wines from different treatments:

1. Low crop
2. Gib. treatment
3. Moderate crop, under pruned, early shoot removal
4. Moderate crop, normal pruning
5. High crop

Effects of Overcropping

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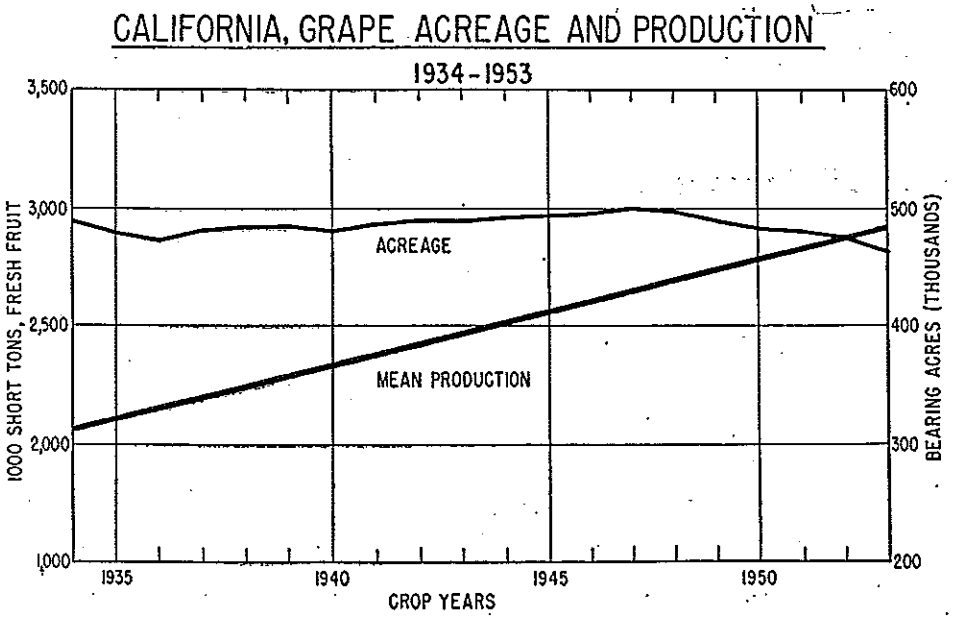
The growers of grapes and wines, like those of any other industry of the same magnitude, are beset with production problems. These stem from such operations as disease control, insect control, irrigation, cultivation, and cropping. If not managed properly, difficulties may arise with either of the operations to cause serious defects in production. During the past two decades the rate of cropping has been the least well managed of the vineyard operations. Overcropping has been the rule in many vineyards. It is the purpose of this paper to indicate some of the deleterious effects of overcropping.

Before turning to the effects of overcropping the trend of cropping in the post-repeal period will be indicated. This is done by the graph for mean production in Figure 1. Production has most definitely gone up. In the past several years the crops have averaged over 40 per cent higher than in the first several years following repeal. This, in itself, might be viewed as healthy expansion of acreage and the result of the utilization of improved cultural practices. Yet, when it is tied in with an almost constant, or of late, a somewhat declining acreage (see Fig. 1) and the fact that the vines of today are little if any larger than those of 20 years ago the tremendous increase in production must surely be considered overcropping. Then, too, it is generally recognized that many vineyards, particularly those of the strictly

FIGURE 1



SOURCE OF DATA: S. W. Shear, Grape Industry Statistics as of November 1951, California Agric. Exp. Sta., Giannini Foundation Report No. 125; acreage 1951-53 California Crop Reporting Service, Acreage Estimates California Fruit and Nut Crops; and U. S. Federal-State Market News Service, California Grapes, Raisins, Wine Marketing, 1951 to 1953.

table grape growers, are cropped at about the same level now as before repeal. Thus, not all of the vineyard acreage is involved in the large increase in crop indicated above which makes overcropping all the more factual.

Some of the Effects of Overcropping

Vines have the capacity to produce only so much fruit and bring it to normal maturity. This is the index to their cropping ability. To increase crop beyond this will result first in a delay of maturing, and if continued or increased will reduce vine growth, result in irregular production, and upset the balance of the fruit at maturity.

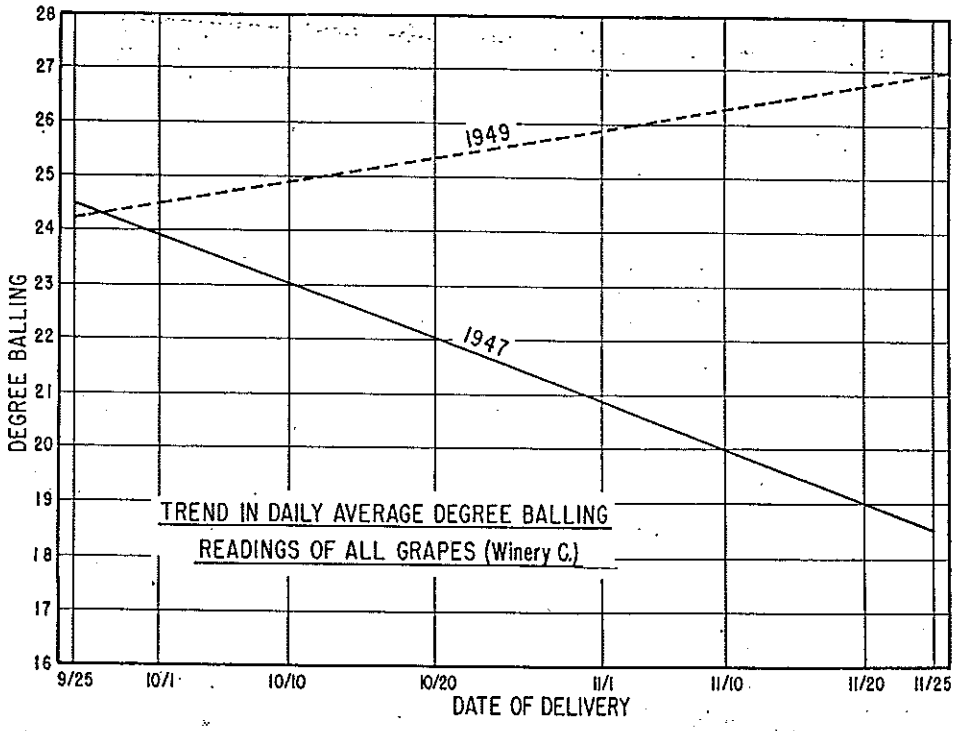
Effect on time of maturing: Cropping is normal when the vines bring their fruit from blooming to the required degree Balling with a given (for a given variety a constant) summation of heat. Overcropping is indicated when a greater summation of heat is required to bring the fruit to the desired degree Balling; that is, maturing is delayed (3).

The delaying effect of overcropping on the maturing of grapes, produced for crushing, is clearly revealed by the grapes (1) delivered to three large interior valley wineries in 1947. The solid graph of Figure 2 shows the average degree Balling reading for each load delivered to one of these wineries. (Approx. 24,000 tons.)

The crop of 1947 was 2,836,000 tons. It followed the slightly larger crop of 1946. Normally grapes become more mature, higher in degree Balling, as the season advances. This was decidedly not the case with the grapes delivered to this winery in 1947. The average daily rate of decrease in degree Balling amounted to .0957 per cent. This regression in total soluble solids was highly significant statistically.

The reversal of the normal trend in degree Balling during this vintage can only

FIGURE 2



SOURCE OF DATA: Mehren, G. L. and W. J. Tater, The use of minimum grape sugar content requirements for control of tonnage of grapes crushed in central valley of California, California Agr. Exp. Sta. Giannini Foundation Report No. 157, 1953.

be explained on the assumption that the riper grapes of the less heavily loaded vineyards were picked first. Then, as the vintage progressed the winery, of necessity, received less and less mature fruit from the vineyards carrying increasingly heavier crops. Thus the fruit of the most heavily overcropped vines which never reached desirable maturity was harvested the latest.

Similar trends in degree Balling were shown by the grapes received by the other two wineries in the same year. In one the rate of regression in total soluble solids was almost as marked (.0776 per cent) as that shown in the solid graph of Figure 2, while in the other it was slower (.0079 per cent). In each case the regression figure is statistically significant.

A somewhat more normal condition of maturing is illustrated by the dashed graph of Figure 2. This graph indicates the average degree Balling reading of each load of grapes delivered to the same winery in 1949. In this year the total State grape crop was 350,000 tons (12 per cent) less than in 1947.

The harvest started on about the same date in the two seasons. The first fruit harvested was also of almost the same degree Balling. This was to be expected since the heat summation in the Fresno area, from April 1 to September 30, for the two years was almost the same (4514 and 4461 degree days, respectively). In 1949, however, there was a gradual increase in the degree Balling readings as the season advanced. This reflected the fact that the crop borne by the vines more nearly approached the amount which they could bring to normal maturity. The slow rate of increase would still indicate some overcropping.

Effect on vine behavior: The effect of overcropping on vine growth and cropping appears to arise from a lowering or depletion of the reserve materials of the vine generally and of the root system in particular. It is generally recognized that the accumulation of reserves in the vine itself is very slow, if it occurs at all, until the fruit approaches minimal maturity. With a delay in maturing, because of overcropping, until the season is practically over the vine is largely deprived of reserves. Growth conditions reflecting extreme vine devitalization have occurred in four different years since repeal.

Following the two very heavy crops of raisin grapes in 1937 and 1938 (1,429,000 and 1,445,000 tons, respectively) there was widespread appearance of so-called "Pink or red" cane in Thompson Seedless in the fall of 1938. These canes contained no starch, hence they did not mature and were killed in the winter. The heavy crops had prevented the normal accumulation of reserves.

In the spring of 1945 many vineyards in the San Joaquin Valley leafed out and then the shoot growth almost ceased for several weeks. The largest crop in history to that time, 2,789,000 tons in 1943, together with the above average crop of 1944 had apparently deprived the root system of the vines of food reserves to the point where root growth was not sufficient to support continued top growth. After a period of arrested shoot elongation, enough food material was derived from the maturing leaves of the shoot to enable the roots to resume growth. With this, shoot development was renewed and the vines and crop developed fairly normally.

Again in 1950 and 1954 following years of record and above average crops the vines in many vineyards exhibited weak growth. In both years extensive damage was done to the vines and crop of the weaker vineyards by sunburn. Some may wonder why the vine should be suffering in 1954 when the 1953 crop amounted to only 2,417,000 tons. It is true that as crops have been running in late years the 1953 crop was very moderate. Yet, with the tremendous crop of 1951 and the heavy crop of 1952 the vines were so depleted that the 1953 crop was still an overcrop. This view is definitely supported by the poor growth of many of the vineyards, the late maturing of the fruit, and the limited formation of fruitful buds for the 1954 crop in some varieties such as Thompson Seedless.

Effect on regularity of cropping: The effects of overcropping on vine behavior, just indicated, have been accompanied by reductions in yield. In some instances the effect on yield preceded the drastic vine

response. Where this was the case, as in 1944, 1949, and 1953, the reduced crop was simply an indication of a weakening of the vine by the very heavy overcrops of the previous year or years. Even the reduced crops of these years proved to be overcrops as indicated by late maturing of the fruit or the severe weakening of the vine for the following year or both. In some instances other factors may have caused minor additional effects, as the sunburn in 1950 and the frost in 1953. Usually after one or two years of moderate crops the vines recovered and sufficient growth was made and fruitful buds formed to set heavy crops with the pruning practices employed.

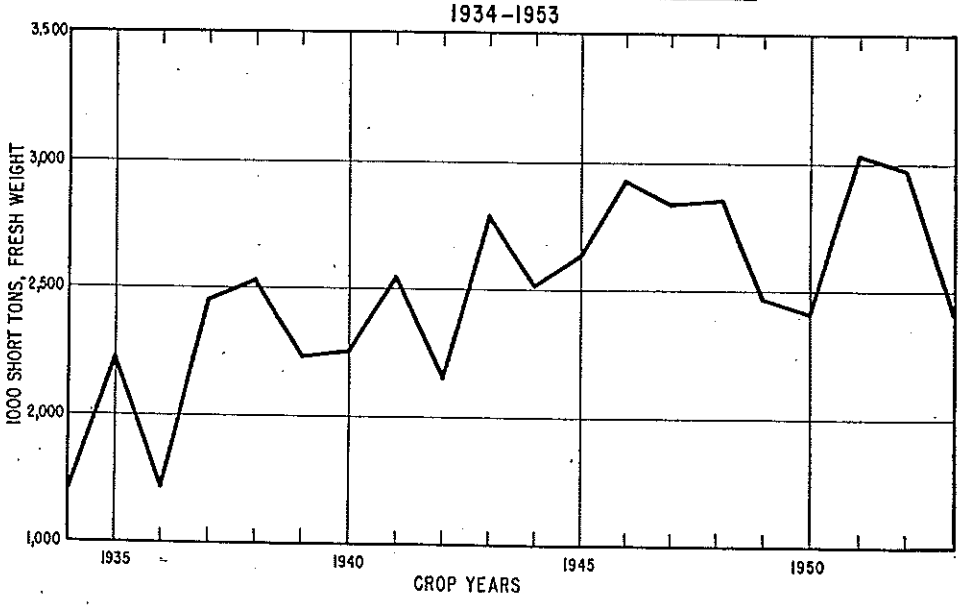
These ups and downs in cropping are clearly indicated by the graph of Figure 3. The crops of four years—1938, 1943, 1946, and 1951—were outstanding in volume. These years of excessive cropping were in each case followed by lower yields. Owing to other conditions, as unusually favorable weather, etc., the years of lowest yield did not always immediately follow the heaviest crops. But they did follow. It would also appear that as the peak crops become larger (1946 and 1951) the following low yields (1950 and 1953) are proportionately lower.

Effect on the utilization of crop: The irregularity in crops that has resulted from the cropping practices employed since repeal has posed problems in crop utilization. In the low crop years there has been a scramble for grapes while in the years of heavy crops purchases have lagged. The utilization of grapes fresh, as for table, canning, and juice has been fairly stable which has left raisins and wines to absorb the remainder of the crop. As a result, there has been tremendous fluctuation in the crush and the lay for raisins from year to year. This is illustrated by the graphs of Figure 4. Since raisin production was obligatory during World War II only the utilization from 1945 to 1953 is shown.

Although the lay of raisins has been fostered in most years by delaying the be-

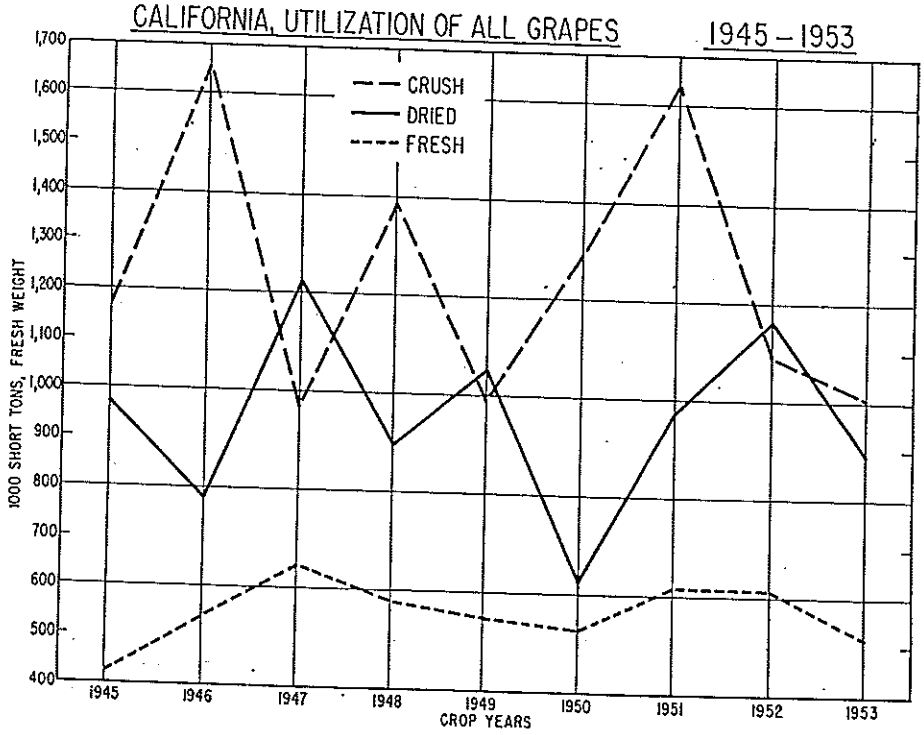
FIGURE 3

CALIFORNIA, FLUCTUATION IN PRODUCTION
1934–1953



SOURCE OF DATA: S. W. Shear, Grape Industry Statistics as of November 1951, California Agr. Exp. Sta. Giannini Foundation Report 125, and 1951-1953 from reports of California Crop Reporting Service.

FIGURE 4



SOURCE OF DATA: 1945-49 compiled by S. W. Shear, Giannini Foundation of Agricultural Economics, University of California and 1950-53 from reports of California Crop Reporting Service.

ginning of crushing in the Fresno area, it has nevertheless been influenced by amount of crop, stage of maturity of the grapes, and the price of wine grapes. In years of moderate crops a fairly equitable utilization of grapes was made. However, in the years of excessive crops and late maturing too few grapes have gone to raisins and, as a result, the wineries took too many for their own good. The fluctuation in the crush thus has been the greatest. In successive years on several occasions it has amounted to almost 600,000 tons or about 60,000,000 gallons of wine.

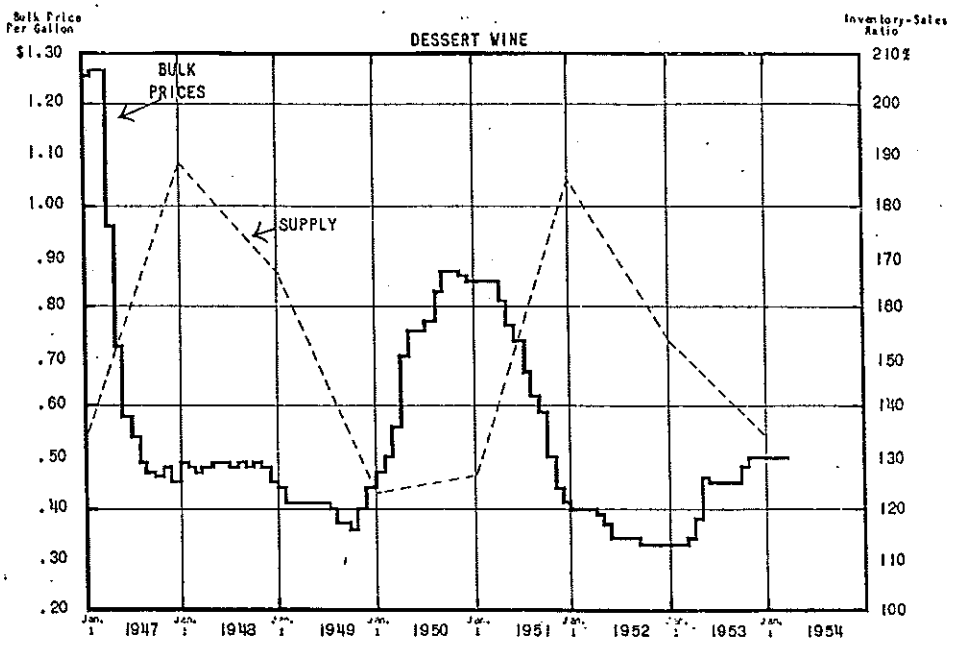
Although the utilization of grapes other than for raisins and wines has been fairly regular, it would be an error to assume that all table variety grapes are so used. The product of these varieties has added materially to the wine inventories and thus to the difficulties of the industry in the years of heavy production.

Effect on prices: The irregularities in production from year to year combined with the still greater fluctuation in utilization for wine has had a most unfavorable effect on supplies and this in turn a drastic effect on price. The graphs of Figure 5, which represent the inventory-sales ratio and price for bulk dessert wines for the years 1947-1954, illustrate this very strikingly. Supply as used in the chart represents the inventory as of January 1, divided by the previous year's sales.

The graphs of Figure 5 hardly need any explanation. The drop in prices came in the year or period of heaviest crops. The drop in 1951 appears to have been in anticipation of the heavy crop. With the industry being plagued almost constantly by a surplus it is hardly surprising that prices have usually been depressed.

FIGURE 5

ANNUAL INVENTORY-SALES RATIOS AND MONTHLY PRICE FLUCTUATIONS OF BULK WINE



SOURCE OF DATA: Wine Institute Bulletin No. 703. (Inventory-sales ratio by the Giannini Foundation and price by Wine Institute).

Graphs representing the inventory-sales ratio and price for bulk table wines for the years 1947-1954 would be very similar to those shown for the bulk dessert wines.

Effect on quality of fruit: Because of the delay in the maturing of the fruit of overcropped vines its compositional balance and texture at maturity are altered. This probably arises from the fact that the rates of change of the different constituents of the fruit are not affected the same by the delay in maturing. For example, the rate of acid reduction remains practically constant, while the rate of sugar accumulation is greatly decreased. Grapes from overcropped vines, therefore, have a higher Balling/acid ratio at the same degree Balling than grapes from vines carrying a normal crop. Representative data on the relation of level of crop to time of maturing, acid content, and quality grade, for three varieties, is shown in Table 1. The different levels of crop were obtained by pruning to retain different numbers of buds. Minor further adjustment of crop was done by thinning in 1953.

The figures of Table 1 indicate that as crop increased the attainment of a given degree Balling was delayed. The delay in each instance was accompanied by a decrease in acidity. Thus, the grapes of the vines carrying heavier and heavier crops had a higher and higher Balling/acid ratio at maturity.

A given degree Balling with a favorable Balling/acid ratio of the grapes at crushing is recognized as a most important factor of wine quality. In each of the varieties tested the fruit of the vines with the lowest level of crop had the most favorable Balling/acid ratio. In several instances, as in the Mission in 1952 and the Zinfandel in 1953, the fruit of the intermediate crop level still had a favorable ratio. Thus, the intermediate crop in these cases was at most only a slight overcrop

TABLE 1
Relation of level of crop to time of maturing, acid content, and quality grade

Variety	Year	Crop in tons	Date of harvest	° Balling	% Acidity	Grade
MUSCAT	1952	5	8-28	22.5	0.56	1
		7	9-4	22.5	.53	3
		11	9-25	21.7	.51	4
	1953	6	9-11	20.0	.58	2
		9	9-30	21.0	.52	4
		12	10-13	20.2	.46	6
MISSION	1952	7	9-22	23.5	.62	1
		9	9-30	23.0	.57	1
		10	10-7	23.0	.35	6
	1953	9	9-28	21.5	.59	1
		12	10-12	23.0	.39	5
ZINFANDEL	1952	5	9-30	23.0	.84	1
		10	10-21	22.4	.67	4
	1953	6	9-9	21.5	1.13	1
		8	9-28	22.2	.83	1
		10	10-12	21.7	.71	4

for the vines in the vineyards used. Maturing was delayed somewhat but the balance of the fruit was still very good. The ratio of degree Balling to acidity was definitely less favorable in all cases at the highest level of crop. The degree of the favorableness of the ratio is indicated by the grades at the right of the table. Grade 1 is best. This grade represents the usual ratio for a variety when it matures a normal crop in a good environment. Grade 6 represents a very poor ratio. Much higher tonnages than those shown here were the rule with these and similar varieties in similar vineyards in many of the post-repeal years.

Much of the trouble experienced by Tokay and Emperor growers in meeting color (4) requirements in recent years arose directly from cropping practices. A brilliant light red is typical for these varieties, yet the crops in many vineyards have been sufficiently heavy to delay color development unduly. The effect of crop levels on coloring is shown in Table 2.

The color requirements (5) for U. S. Fancy, well colored table grapes is 60 per cent for Tokay and 75 per cent for Emperor. The figures of Table 2 show that these percentages of color had not been attained by the fruit of vines carrying

TABLE 2
The effect of level of crop on color development

CROP	Clusters to a vine		Percent colored	
	Tokay	Emperor	Tokay	Emperor
Light	24		71	
Normal	32	25	65	94
Medium heavy	44	35	59	71
Very heavy	60	40	51	64

more than a normal crop by the time the minimum degree Balling for the grade was reached.

The coloring of wine grapes is similarly affected by level of crop. This is not so readily observed since most black wine varieties are completely colored before they attain full maturity. That color development is deficient in the fruit of overcropped vines has been indicated by numerous wineries in both the coastal and interior valleys. This observation is further supported by the extensive use, even at much higher prices, of the Salvador which has intense color but which is a poor wine grape.

That the softening of the texture of grapes of heavy crops is more advanced than that of normal crops at the same degree Balling has been recognized as of common occurrence in table grapes. It would appear that grapes which must hang on the vines beyond the normal time to attain a given degree Balling become physically overmature. Such grapes are more susceptible to handling and transportation injury. This type of deterioration would be even more severe in wine grapes that must be hauled considerable distances since they are naturally of softer texture.

Summary and Discussion

The data presented definitely show that the general practice of ovrecropping since repeal and particularly since World War II has resulted in:

1. A delay in maturing. In some years much fruit failed to reach minimum maturity for the production of standard wines or raisins.

2. Both vine growth and fruiting have been seriously upset in some years.

3. Total crop has varied drastically between years.

4. With a demand that would have been met by normal crops in all years the heavy crops have led to great fluctuations in utilization.

5. Persistent surpluses have kept prices depressed.

6. Owing to the need for a more extended period on the vines to attain a minimum sugar content the fruit of vines carrying excessive crops has been low in acid content, deficient in color, and soft in texture.

In view of these deleterious effects of overcropping one may well ask why did this practice get started and why has it been continued? It came into use during World War II when anything resembling a grape could be sold at a profit. Since the War the growers have been caught between falling prices for their products and rising prices for what they had to buy; thus, to ease the economic pinch they have continued to produce more grapes per unit area by leaving more buds at pruning. They were abetted in this by the general woeful lack of appreciation of sound and normally mature grapes by many wineries and raisin processors who have provided a home for all available grapes regardless of quality.

In addition to the production of much fruit of poor quality the continued practice of overcropping has beset the grape industry with a continuing surplus of grapes and products of the grape (2). The surplus has amounted to between 10 and 12 per cent of the total annual crop. Even the below-average crops of 1949, 1950, and 1953, have not enabled the industry to get out from under the price depressing surplus.

Again the question arises as to why industry has not done something about the surplus? It has, but nothing very effective. In 1938 a pro-rate was put into effect to divert surplus grapes into brandy. The fact that this was not again employed in later years speaks for its success.

More recently many ideas and plans have been advanced for the removal of the surplus. These have included plans for "set-asides", green drop, acreage reduction, and the like. Yet, none of these plans will really solve the problem since they have, in each case, failed to include quality control. Without some quality standard they create the incentive to further overcropping of the acreage not eliminated or the vines not under control. With continued further overcropping the capacity of the vines of many vineyards will be more sorely taxed than now which would result in even wider fluctuations in vine behavior and crop from year to year. The grapes

of such vines would be of lower quality than those of past years.

It must become apparent, then, that the only means of effective surplus control of grapes for crushing and for raisins, as in table grapes, is one that involves quality control. The most adaptable means of quality control now available for grapes for crushing is that based on degree Balling and acid content of the fruit. This may be applied as grade standards of quality. In such a classification grade 1—the highest quality—represents the ratio of degree Balling to acid content of the fruit at a given degree Balling when the variety matures a normal crop in a favorable environment. The higher grade numbers represent an increasingly less favorable ratio or less desirable quality. Few or a number of grades of quality may be used. The system is very flexible and therefore readily adaptable to the control of small or large potential surpluses.

For grapes for raisins a minimum degree Balling standard is sufficient to insure a quality product, since overcropped grapes which would produce too low acid content raisins would not ripen in time to permit sun drying. When such grapes are diverted for crushing they would be subject to the wine grape quality grade standards.

In practice the application of grade standards of quality would, if supported by sufficient differentials in price, tend to balance crop and vine capacity. If such a system would have been in effect since 1945 it would have all but eliminated the surplus. There would have been an incentive to grow better grapes and peak crops would have been prevented. The prevention of overcrops would have maintained vine vigor, insured the development of ample fruitful buds each year and minimized sun burn. Thus, fluctuation in crop from year to year would have been brought within the limits of weather and other factors beyond the grower's control. Regularity of cropping at or near the demand level would also have gone far to stabilize the utilization of grapes by the three principal phases of the industry.

The workability of the grade standards of quality for grapes for crushing has in recent years been demonstrated by several wineries.

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ABSTRACT

Production in its various effects continues to be one of the principal problems of the grape industry. Feast years to the grower are famine years for the vines which lead to years of lower production. This unbalanced condition of crop and growth leads directly to a number of other conditions all of which are unfavorable for the industry. The most obvious of these is the effect of irregular bumper and small crops on the stability of the markets. Then, there are the effect of level of crop on the balance of the fruit and maturity. Of these the more important are the compositional balance of the fruit, the reduction in flavor, the effect on texture, and the effect on the character of the wine produced.