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THE EFFECTS OF PERMANENT COVER CROPPING ON A NONIRRIGATED WINEGRAPE VINEYARD IN THE NAPA VALLEY

This topic was presented at the January 1982 California Weed Conference by DeWitt H. Garlock, viticulturalist for Mount La Salle Vineyards in Napa Valley which is owned by the Christian Brothers. He has kindly given us permission to disseminate his presentation via this Technical Note.

The perennial and annual cover crops used were in a Field Planting through the SCS Napa Field Office and Napa County Resource Conservation District. Seed was furnished by the SCS Lockeford Plant Materials Center.

Establishment of six different cover crops and their affect on soil moisture in the vineyard is reviewed. Also discussed is the question of cover crop impact on crop yields.

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The Effects of Permanent Cover Cropping on a Nonirrigated Winegrape Vineyard in the Napa Valley

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ABSTRACT

A study was begun in 1978 to observe the long range effects on Cabernet Sauvignon wine grapes from three introduced cover crop species grown under non-irrigated vineyard conditions in the Napa Valley. Historically, optimum vineyard yields and ultimate grape quality have been functions of varying degrees of mechanical tillage. This is because of the need to retain as much of the available moisture capacity for as long as possible throughout the growing season, especially where irrigation was not feasible. Vine production and fruit quality figures normally attained under a tillage operation were used as a comparison with no-till to determine if real changes were occurring in the bearing capacity of the vineyard. Also, the relative success in the establishment of the cover crops was observed.

In comparing till versus no-till, it was found that there were no significant differences in fruit production including total vine yield, cluster weights, cluster counts, and estimated tons per acre for both sample years 1980 and 1981 ($p < .05$). There were also no significant yield differences between cover crop treatments. However, a significantly lower degrees Brix was found in 1981 in one cover crop species ("Pomar" dwarf orchardgrass) when compared with the control, while all others were statistically the same as the control. Total acidity and pH did not differ between treatments.

Pruning weights as a measurement of growth on a per vine basis did not differ between till and no-till in 1980. The 1981 results are not yet available.

No-till in the Napa Valley may be of great importance where cost savings can be realized, and some other advantages are possible to attain such as less fruit sunburn and the reduction of some insect problems. From the results of this trial, permanent cover cropping appears to cause no detrimental effects on overall fruit and growth production and possibly has only a minor effect on fruit quality. Testing is continuing with the establishment of a commercial size plot (43 acres) in the fall of 1981 with supplemental irrigation.

DISCUSSION *

Permanent cover cropping is nothing new to California agriculture, particularly to table grape growers and fruit tree growers in the Sacramento and San Joaquin Valleys. This form of vegetation management has been practiced in these areas for many years to enhance fruit quality and to aid in water penetration, reduce the incidence of some insect problems, and to aid in harvest. Even in the North Coast, cover cropping has been tried though it never really has caught on as an established cultural practice in wine grape vineyard management. This may be due to the historical interest in mechanical tillage because rainfall tends to be high, the soils are heavy in clay and hold a great deal more moisture than sandy soils, and as a result vineyards in this area have traditionally been nonirrigated.

Things have changed since the old days, however, and many vineyards are now under some form of irrigation. It is apparent then that with irrigation permanent cover cropping would be possible. A paradoxical situation arises where vineyards are grown on deep soil, overproduction of vegetative growth at the expense of crop is a problem, and irrigation should not be practiced. Cover cropping in this kind of vineyard could shift the balance back towards crop production if the cover crop had a longevity and a root system that was deep enough to compete.

The experiment originally began as an attempt to observe the relative degree of success in establshing cover crops under a nonirrigated regime, and the long term effect on vine and wine quality. Data taken from a preliminary test initiated in 1976, which involved mowing the native cover crop only without introducing any new species, had shown a loss in vine vigor and some crop production. This, of course, was not a desired result for a normally balanced vineyard such as the one in which this plot was located. Also, this practice did not favor renewal of the winter annual weeds such as common mustard, filaree, and wild oats. Instead, we found ourselves battling undesireable weeds, ground squirrels, gophers, and soil

* footnote; From a speech given at the California Weed Conference in Jan. 1982 by the author.

that hardened to about the same consistency as cement. This first phase of our project was abandoned.

From these findings it was decided only an introduction of a cover crop could be successful. By introducing a perennial cover or an adaptable annual cover, we felt that we could solve our problems with noxious weeds and development of a poor soil structure and at the same time find a deeply rooted cover crop that might afford some competition for future use in a vineyard having the previously mentioned vigor problems.

To accomplish this, we had to first test the success in establishing various cover crop species, both annual and perennial, under dry farm conditions. Secondly, we had to decide which species would tend to explore the moisture profile most fully by comparing profile mositure depletion between the different cover crops and tilled rows. Thirdly, we would study vine response, either positive or negative, in terms of growth yield, crop, and fruit quality. Finally, we would establish a larger, commercial size plot of 40-50 acres in a vineyard with a vigor problem and study further the crop/growth relationship and the possible added cost saving benefits by going completely to no-till.

In the fall of 1978, seeds of six cover crop species were broadcast in a small test plot approximating 3/4 of an acre. The varieties tested were provided by the Soil Conservation Service as being species which they felt would be promising for conditions in our growing area, and also in our particular test. The cover crops were allowed to reseed themselves over a two-year growing period before data collection was begun. This was necessitated primarily because of the relatively slow development period experienced.

Since we wanted to try establishment under "worst case" conditions, that is without supplemental irrigation, though irrigation was available, we applied none and had to wait for fall rains to germinate the seed. Unfortunately, these rains and germination and establishment were erratic in 1978.

In 1980, three of the test crops were eliminated because of little or no success in establishment. These were Kalo dwarf English trefoil--a perennial legume, Wimmera 62 rygrass--an annual, and Mt. Barker subclover. The three successful varieties were "Blando" brome--an annual grass, "Pomar" dwarf orchardgrass--a deep rooted re-seeding perennial bunchgrass, and "Zorro" annual fescue--also an annual grass.

The Soil Conservation Service installed neutron probe access tubes throughout the plot and readins were taken at depths ranging from 6 inches to 9.5 feet. Monitoring of seasonal soil moisture has been ongoing since 1979 in both the till

and no-till plots. Annual weed control under the vines was obtained by strip spraying Princep pre-emergent herbicide along with Roundup herbicide as a translocative at 5 lbs. and 1.5 quarts per acre respectively in 48" row centered bands.

The cover crops were mowed twice, once during the winter prior to seed head formation along with the normal brush chopping operation, and again in the late spring following seed dry-down.

Summer bindweed control in the spray bands was accomplished with use of Roundup at 4 quarts per acre. No summer perennial weed control with herbicides occurred in the middles between the rows even in the annual cover crop treatments. It was noted that as the annual cover crops became better established, perennial weeds became less of a problem.

Vine measurements were begun in 1980 with crop and pruning yield data. Measurements were taken from vines in the Blando brome treatment and from the control vines which were normally tilled. Normal tillage for each year included two discings, one french plowing, and a light cultivation in midsummer. This particular annual was chosen for comparison, because after two years it appeared to be better established than the Zorro annual fescue or the Pomar dwarf orchardgrass. The vine yield data for 1980 displayed in Table 1 shows that there was no significant difference between till and no-till for both average cluster counts per vine and cluster weight. The estimated tons per acre yield also showed no statistical difference. It is interesting to note that the estimated tons per acre for no-till is .6 tons higher than for the till vines. If this difference were real, it could mean that our vines are getting more productive under no-till.

When considering growth yield in pounds of prunings per vine, there was almost a one-pound difference between till and no-till, but this was not significant. This parameter suggests in this case that there is no measurable effect from cover crop competition, at least where the annual was growing. After two years then, it appears that no-till is not influencing our vineyard.

The 1981 crop yield data displayed in Table 2 shows virtually the same picture as in 1980. We expanded our data collection to include the Pomar dwarf orchardgrass and the Zorro annual fescue, as these had now appeared sufficiently established. In comparing Pomar with the control, it had 3.7 lbs. per vine less yield than the control. This difference, however, was not significant. It might suggest that our vines are losing some productive capability as this is the lowest figure for all treatments. Our 1981 pruning yield data does not bear this out. There is also no statistical difference for the cluster counts found per vine.

Though the vines in the Pomar treatment had higher cluster weights per vine than the control, this again was not a real difference but due rather to natural variation. Data for the annual grass treatments again varies a little from the control but essentially all of the vines are the same as the control in fruit production.

We find a significant difference in the fruit quality data. The sugar content in the mature fruit in the Pomar treatment is significantly lower than the check and the Zorro annual fescue. There is no difference between Pomar dwarf orchardgrass and Blando brome. This drop in sugar content, however, is felt to have been due to other factors than cover crop affect, namely a higher incidence of leafroll virus which is present in a mild form in this plot. It is also possible that this difference is due to water stress, brought on by increased competition by our cover crop. We will collect this data again in 1982 to see if there is repetition of it. The total acidity in the juice did not vary among treatments but the juice pH did. Again, the Pomar dwarf orchardgrass was significantly lower than the control and Blando brome but not the Zorro annual fescue. This finding again may be a result of leafroll virus or vine/cover crop water relations. It is an interesting one since it is well known that pH plays a signifiant role in wine quality.

Looking at the 1981 pruning yield data in Table 3, we again find no significant differences in any of the treatments for any of the parameters studied. Brush yields as measured in pounds per vine show no differences over the control even for the Pomar dwarf orchardgrass. In fact, our tilled vines show the lowest brush yield which is exactly the opposite result we were looking for. Buds, canes, and spurs retained after pruning, which are all indicators of vine size and potential crop production for the following year, are statistically the same. This second years' data again shows that there is no affect from cover cropping on the vines annual growth cycle.

Our third area of study in this project was to observe the moisture conditions in the soil profile with the neutron probe and to try to approximate water use in the perennial and annual covers as compared with the control. It was felt that this data would help explain yield differences or similarities and the relative degree of competition. The probes were established in 1978 and, as previously mentioned, much of the first two years data gathering was spent in calibrating the instrument to find the best standard curve to fit the soil textural changes. The 1981 season data represents the first comparison as measured in the top 3 feet of soil.

At budbreak it was found that the moisture profile in both the annual and perennial covers was higher and closer to being at field capacity than the control. This is thought to show improved water penetration because of breakup of the plowpan by the cover crop roots and the cessation of heavy equipment movement over the ground. If we look at the water use, that is by measuring the difference between the high and low points on each line of the graph, we see that the perennial cover usage prior to irrigation was greater than the annual cover; the net difference was 3.2" for the perennial vs. 1.7" for the annual. This result was expected as by the time irrigation was applied, the annual cover had dried up and seeded out, and its water use had ceased. The control profile showed a difference of 4.4" or about 1.2" higher than the perennial cover for this same period. This may have been due to several factors, one possibility being there was a 60 percent to 70 percent stand of perennial cover in the plot instead of 100 percent. Prior to budbreak then, two out of the three profiles were at field capacity, and the control profile was somewhat less than field capacity.

The use figures for the entire growing season between budbreak and harvest were 7.5", including irrigation for the annual cover profile; 7.9" for the control profile; and 8.1" for the perennial profile.

This overview shows that water usage from the annual cover was pretty much the same kind of usage found where winter annual weeds had been growing in the control rows. Probably the main differing effect would be from the change in micro-climate caused by covering of the soil surface by the annual cover crop residue. This probably eliminated some evaporative loss from the soil surface.

The seasonal usage figure for the perennial is also basically the same as the control, although the actual figure is slightly higher. This is due to the continued consuptive use of the cover crop as well as that of the vines throughout the season. We expected a greater spread between these two measurements, and our difficulty in obtaining this may again have been due to less than 100 percent stand.

After our experiences in establishing cover crops in the Napa Valley and our data measurements in 1980 and 1981, we can begin to make some very general conclusions. We originally started the establishment phase of this project by trying the simplest approach: mowing the native cover and studying the effects of this. We found this to be disadvantageous primarily because of the poor soil structure that is developed. Other problems were the influx of undesirable weeds and vertebrate pests, and the subsequent loss of vine vigor and production, probably due to development of poor soil structure.

The introduction of a new species of cover crop is best done under irrigated conditions, as we found that fall seedbed preparation and reliance on early rainfall is difficult and increases the time required for establishment of a suitable stand. This is especially true where the species chosen is inherently slow to grow and necessitates an early start to compete with more rapidly growing native weeds and to survive cold wet winters.

Though we have not as yet answered our original question about successful competition with overly vigorous vines, time may eventually show that perennial cover cropping is one answer to this commonly occurring problem in our area. At least at this time we can say that there may be no detrimental affects in an over-growing vineyard, and of course cost savings through no mechanical tillage should be an obvious advantage. We have some indication also that the soil structure and water permeability are improved. There have been no outstanding perennial weed or vertebrate pest problems and, although no unusual insect or disease problems have been noted, there is good reason to continue monitoring these factors. It should also be mentioned as a word of caution that the establishment of a perennial in a normal, productive, nonirrigated vineyard is of doubtful value. Though our data did not show clear differences, there are good reasons to continue mechanical tillage for vineyards with soils of limited depth or water-holding capacity.

There is much more that can be said on this subject and much more to study. The issue of wine quality, for example, has not been explored here. We feel that because there have been no negative effects, there is a future for this cultural technique in certain vineyards in the Napa Valley. This past fall we proceeded with the establishment of 40 acres of Pomar dwarf orchardgrass in a very vigorous Cabernet Sauvignon vineyard. We feel that to continue to test the competition aspect, in hopes of increasing crop yield in this vineyard and also to better ascertain the actual cost savings, is necessary. We hope that our confidence is justified.

Table 1. Crop yield and pruning data from the cover crop trial, 1980 data.

	Yield			Pruning			
Treatment	Estimated Yield (t/a)	Clusters per vine	Cluster Weight (g/cluster)	Prunings (lb/vine)	Buds retained	Fruit canes retained	Spurs retained
Control (Till)	5.50[a]	71.9[a]	126.4[a]	8.13[a]	42.7[a]	2.3[a]	5.2[a]
Blando brome (No-till)	6.11[a]	74.5[a]	130.8[a]	7.26[a]	40.8[a]	2.2[a]	5.6[a]

Columns with differing letters indicate a statistically significant difference at the 5% level using the students t-distribution.

Table 2. Crop yield and quality data for the cover crop trial, 1981 data.

	Yield				Fruit Quality		
Treatment	Yield (kg/vine)	Estimated Yield (t/a)	Clusters per vine	Cluster Weight (g/cluster)	Brix (%)	Total Acidity (g tartaric acid/100 ml)	pH
Control (Till)	13.1[a]	6.26[a]	106.6[a]	98.3[a]	23.6[a]	.81[a]	3.32[a]
Blando brome (No-till)	12.8[a]	6.31[a]	90.1[a]	118.0[a]	23.3[ab]	.82[a]	3.33[a]
Pomar dwarf orchardgrass (No-till)	11.4[a]	6.03[a]	94.3[a]	108.9[a]	22.7[b]	.84[a]	3.16[b]
Zorro annual fescue (No-till)	14.4[a]	6.39[a]	99.1[a]	108.9[a]	24.0[a]	.78[a]	3.24[ab]

LSD = .80

Columns with differing letters indicate a statistically significant difference at the 5% level using the students t-distribution.

For actual comparison, the production in tons per acre of the test site vineyard was 6.51.

Table 3. Pruning yield data from the cover crop trial, 1981-82 data.

	Prunings (lbs/vine)	Buds retained	Fruit canes retained	Spurs retained
Control (Till)	7.5[a]	45[a]	2.6[a]	5.0[a]
Blando brome (No-till)	8.2[a]	49[a]	2.7[a]	5.4[a]
Pomar dwarf orchardgrass (No-till)	8.6[a]	45[a]	2.6[a]	4.6[a]
Zorro annual fescue (No-till)	7.8[a]	48[a]	2.7[a]	5.4[a]

Columns with differing letters indicate a statistically significant difference at the 5% level using the students t-distribution.