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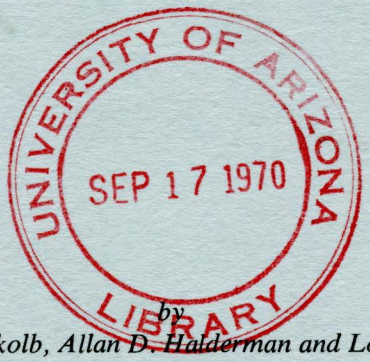
EVALUATION OF BIOCHEMICAL SOIL ADDITIVE VINEYARD STUDY



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Evaluation of Biochemical Soil Additive
Vineyard Study

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A two-year study was initiated in March 1968 on Thompson Seedless Grapes at the Roach-Baker Vineyard near Litchfield Park, Arizona. The study was conducted in order to evaluate the effect of a biochemical additive on grape yield and certain quality factors as well as various soil factors.

The product was furnished and sprayed directly on the soil by a division representative of the Company in accordance with their recommended practices and rates. The usual rate of application when spraying is 35-50 gallons per acre.

The study was designed as a randomized complete block consisting of two treatments and eight replications with two sub-samples. The treatments consisted of an untreated control and a treatment with the product. Buffer zones of approximately 18 feet (3 vines) between replications and 12 feet (1 row) between treatments within replications were left to prevent contamination of the untreated plots. See Appendix A for the field plan.

Soil samples were taken in March 1968 from the 0- to 1-foot depth near the vine to be harvested in each of the subplots prior to any treatment; subsequent soil samples were obtained in the same manner during the next two years. The soil samples were analyzed for nitrate (colorimetric determinations on a carbon dioxide-water extract); phosphate (colorimetric determination on a carbon dioxide-water extract); electrical conductivity (saturation soil extract); and organic matter content (dichromate method). All the samples were analyzed by the Soil and Water Testing Laboratory in the College of Agriculture at the University of Arizona.

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The following information regarding dates of application of the product was supplied by the Company:

Date	Equivalent Application Rate (gallons per acre)
1968	
April 19	67
April 30	67
May 10	67
May 27	67
June 10	67
June 18	67
July 24	67
September 14	67
1969	
March 25	84
April 16	67
May 15	67
June 17	67
July 10	67

Unbuffered cylinder infiltrometers were used for the infiltration studies. Evaluations of treatment effect on cumulative water intake in 12 hours were conducted on the following dates:

1968	1969
April 29	March 18
July 25	July 2
	October 7

During the 1969 grape season, soil moisture samples were taken just prior to the infiltration studies in March and July to determine the effect of treatment on soil moisture.

The samples selected for berry size determinations and refractometer readings were taken just prior to harvest on July 9, 1968 and July 15, 1969. Four clusters per subplot were selected at random in 1968; two clusters per subplot in 1969. Average weight per berry was calculated on the basis of the weight and number of berries per sample. The vines were thinned and harvested by commercial thinners and pickers supplied by the grower and packer. Harvests were conducted on July 9, 1968 and July 19, 1969.

Total yield and weights of Grade 1 and Grade 2 were obtained from the center (one) vine of nine vines in each subplot.

Statistical analyses were made as a split block in time in order to evaluate the effects of treatment with respect to time, during the season for soil organic matter content and water intake rate and during the two seasons for yield, berry size and refractometer readings. Other variables were analyzed as randomized complete blocks.

The treatment means for different sampling dates, obtained from soil analyses for nitrate, phosphate and electrical conductivity of a saturation soil extract, are shown in Table 1. There were no significant differences between the levels of nitrate, phosphate, or salinity at any of the sampling times. It is interesting to note the very high levels of nitrate and phosphate at the beginning of each season and the decrease in the level of these nutrients as the season progressed. The salinity levels in the soil tended to increase as the season progressed.

The treatment means of soil organic matter content for the 1968 and 1969 seasons are shown in Table 2. There were no significant differences between the treated and untreated plots at any sampling time. However, some slight changes in soil organic matter content were found with time. In 1968, the April and July mean soil organic matter contents of 0.64 percent and 0.65 percent respectively, were significantly lower than the March mean level of 0.77 percent. In 1969, the May mean soil organic matter content of 0.64 percent was significantly lower than the March and October mean level of 0.73 percent and 0.75 percent respectively.

The effect of treatment on the yield of grapes, berry size and refractometer reading is shown in Table 3. No significant difference between treatments, years, or any interaction was detected for any of these yield or quality factors, except that the berries were larger in 1969 on both treated and untreated plots.

Table 1. The Influence of Treatment on Nitrate, Phosphate and Salinity Levels in the Soil.

Sample	Nitrate			Phosphate			Salinity[1]		
	Untreated	Treated	Least Sig. Diff.	Untreated	Treated	Least Sig. Diff.	Untreated	Treated	Least Sig. Diff.
	ppm			ppm			m mhos/cm		
March 1968	45	33 N.S.[2]	26.7	39	33 N.S.	21.2	0.61	0.56 N.S.	0.16
April 1968	14	14 N.S.	4.2	20	17 N.S.	5.9	0.67	0.77 N.S.	0.17
July 1968	4	4 N.S.	2.2	19	19 N.S.	7.3	0.94	0.94 N.S.	0.10
March 1969	37	40 N.S.	12.6	86	82 N.S.	12.9	0.83	0.82 N.S.	0.14
May 1969	29	33 N.S.	12.3	24	17 N.S.	12.9	0.89	0.98 N.S.	0.18
October 1969	18	18 N.S.	13.6	25	16 N.S.	15.6	1.13	1.17 N.S.	0.30

[1]Salinity is expressed as millimhos per centimeter of electrical conductivity in a saturation soil extract.

[2]No significant differences between treatments at the 95 percent confidence level.

Table 2. The Influence of Treatment on Soil Organic Matter Content for 1968 and 1969.

	1968		
	March	April	July
Number of Applications	0	1	6
	percent		
Treatment			
Untreated	0.74	0.64	0.65
Treated	0.81	0.64	0.65
Date:	0.77 z[1]	0.64 y	0.65 y

Least significant difference to test treatment differences at each date: 0.11

	1969		
	March	May	October
Number of Applications	8	10	13
	percent		
Treatment			
Untreated	0.73	0.60	0.76
Treated	0.74	0.67	0.73
Date:	0.73 z[2]	0.64 y	0.75 z

Least significant difference to test treatment differences at each date: 0.15

1 & 2 Values followed by the same letter are not significantly different at the 95 percent confidence level within each year.

Table 3. The Influence of Treatment on Yields, Berry Size and Refractometer Reading of Thompson Seedless Grapes for 1968 and 1969 Harvests.

Treatment	Weight of Grade 1[2]		Weight of Grade 2[2]		Total Weight[3]		Berry Size		Refractometer Readings	
	1968	1969	1968	1969	1968	1969	1968	1969	1968	1969
	-- pounds --		-- pounds --		-- pounds --		-- grams --		--percent--	
Untreated	32.4	29.6	2.8	9.6	36.3	39.3	2.99	3.55	17.3	18.2
Treated	25.4	31.0	6.2	9.6	31.8	40.7	2.95	3.41	16.6	18.1
	N.S.[1]	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.
Least Significant Difference	12.4	12.4	8.2	8.2	10.8	10.8	0.42	0.42	1.7	1.7

[1]No significant differences between treatments at the 95 percent confidence level.

[2]Weights given are based on pounds of grape clusters per subplot, center (one) vine.

[3]Total weights do not represent the sum of grade 1 and grade 2 due to the effect of cull weights.

Data presented in Table 4 show the effect of treatment on water infiltration into the soil. No treatment effect on cumulative water intake in inches per 12 hours was detected at any time during the two-year study. There was a significant difference in water intake between dates but no significant interaction between date and treatment.

The percent moisture in the soils at the time of the infiltration studies conducted in March and July 1969 is shown in Table 5. There was no significant difference in soil moisture content as a result of treatment. When soil moisture content was subjected to a linear correlation analysis versus cumulative water intake per 12 hours, significant negative correlation coefficients were detected. The correlation coefficients for the March and July studies are $r = -0.63$ and $r = -0.71$, respectively, i.e., the higher the percent moisture in the soil, the lower the infiltration rate. However, since there was no statistically significant treatment effect on soil moisture content, the decrease of infiltration rate as a function of increased soil moisture content was independent of treatment. To verify this, an analysis of covariance was made to permit comparison of intake rate values corrected to a common soil moisture content. This analysis confirmed that water intake in 12 hours on the treated plots was not significantly different than that on the untreated plots.

Based on information contained in this report, the investigators conclude that, for the conditions of this study, treatment with the product did not have a statistically significant effect on soil nitrate level, soil phosphate level, electrical conductivity of a saturation soil extract, soil organic matter content, yield of grapes, quality of grapes, cumulative water intake in 12 hours or percent soil moisture. If a real difference did exist, it was not detected by this test.

Table 4. The Influence of Treatment on Cumulative Inches of Water Intake for Unbuffered Cylinder Infiltrometers.

	1968	
	April	July
Number of Applications	1	6
Treatment	------inches per 12 hours------	
Untreated	10.48	11.73
Treated	9.86	11.18
Date:	10.17 y[1]	11.45 z

Least significant difference to test treatment differences at each date: 2.37

	1969		
	March	July	October
Number of Applications	8	12	13
Treatment	----------inches per 12 hours----------		
Untreated	5.23	8.11	10.12
Treated	4.53	8.41	9.29
Date:	4.92 x[2]	8.26 y	9.71 z

Least significant difference to test treatment differences at each date: 2.95

1 & 2 Values followed by the same letter are not significantly different at the 95 percent confidence level within each year.

Table 5. The Influence of Treatment on Soil Moisture Content.

Treatment	March 1969	July 1969
	percent	
Untreated	10.4	10.5
Treated	10.5	10.8
	N.S.[1]	N.S.
Least Significant Difference	1.0	0.8

[1]Treatment means are not significantly different at the 95 percent confidence level.

APPENDIX A
FIELD LAYOUT
ROACH-BAKER VINEYARD