A. Blake Brophy

[redacted]

TUCSON, AZ 85716

March 31, 1983

Director
Bureau of Alcohol, Tobacco and Firearms
1200 Pennsylvania Ave., NW
Washington, D.C. 20226

Re: Designation of an American viticultural area -- Sonoita Basin

Dear Sir or Madam:

As an interested party, I am hereby petitioning for the designation of an American viticultural area for the "Sonoita Basin" of southeastern Arizona.

The writer is a General Partner of the Babocomari Ranch Company, an Arizona Limited Partnership. The Babocomari Ranch Company is a major landowner in the Sonoita Basin and, since 1975, it has been cooperating with the University of Arizona in experiments for the growing of vitis vinifera and the making of wines from the same. Also, since 1979, the Babocomari Ranch Company has had two independent commercial growers cultivating vitis vinifera on its Sonoita Basin property, and a winery is scheduled to be constructed at the site this summer.

1. The name, Sonoita Basin, is derived from a visita established in 1691 by the missionary-explorer, Father Eusebio Francisco Kino. At that time, the name given to this small settlement of Sobaipuri Indians was Los Santos Reyes de Sonoita. The name is retained today by the only viable community in the basin, the town of Sonoita, located in its western portion.

2. The term, Sonoita Basin, for the area under consideration is of relatively recent usage, since it is geological nomenclature employed to describe or delineate a specific area that is peculiar to the "Basin and Range" surface geology of this

part of the Southwest United States. It has been a name employed chiefly by geologists, but in recent years it has come into more common usage, due mainly to interest in oil exploration in this part of the Overthrust Belt. The "old timers," all of whom are gone, used to refer to the area as the Sonoita Valley, but, as we shall see from the following, the use of "valley" was a misnomer.

3. The reason the area under consideration is a basin, rather than a valley, is that it comprises the headwaters for three distinct drainages: Sonoita Creek to the south; Cienaga Creek to the north; and Babocomari River to the east. From the University of Arizona's researches into wine-grape cultivation in the area, it has cited the major soil associations in the basin, which are suitable for such agriculture. They are the White House-Bernadino-Hathaway and the Caralumpi-Hathaway. These soils are classified as Thermic-high for the cultivation of fine wine grapes and "are found at altitudes above 1200 m, on hillside area(s) where good air drainage exists. . . . Sites studied included Sonoita (Basin), Arizona. . . ." (Enclosed: Dutt, Mielke and Wolfe, "The Use of Soils for the Delineation of Viticultural Zones in the Four Corners Region, *American Journal of Enology and Viticulture*, Vol. 32, No. 4.) The most obvious distinction to the area is that, in its native state, it is classified as "high desert grassland," while the surrounding terrain is either mountain or woody-shrub desert. (See Humphrey, Robert R. *The Desert Grassland*, The University of Arizona Press.) The wine-growing zones of the basin lie chiefly between the 4,500 and 5,000-foot levels.

4. Due to the basic fact that the area under consideration is a basin, rather than a valley, it is impossible to follow specific contour levels to delineate the area. In other words, there is no homogeneity or overall uniformity to the area; rather, it is a type of terrain within a specific altitude range (4,500 to 5,000 feet) that has been formed from the upthrusting of three major and contiguous mountain ranges. Therefore, the following description of the Sonoita Basin will utilize uni-directional lines from and to highly visible and strategically located topographical features, necessarily including more terrain than is suitable for wine-grape cultivation, but still geographically and geologically constituting the basin.

a. Beginning at Mount Wrightson Peak in the Santa Rita Mountains range, in a southeasterly direction for approximately 24 miles, to Lookout Knob in the Canelo Hills;

b. from Lookout Knob, in a westerly direction for approximately 10 miles, to Huachuca Peak in the Huachuca Mountains range;

c. from Huachuca Peak, in a north-northwesterly direction for approximately 21 miles, to Granite Peak in the Whetstone Mountains range;

d. thence, from Granite Peak, in a west-southwesterly direction for approximately 26 miles, to Mount Wrightson Peak in the Santa Rita Mountains range, the point of beginning.

5. The accompanying map, with the above-described boundaries marked in red, is a composite of seven different 15-minute series USGS maps, which are labeled: BENSON, FORT HUACHUCA,

SUNNYSIDE, ELGIN, LOCHIEL, MOUNT WRIGHTSON, and EMPIRE MOUNTAINS. The area under consideration lies in parts of Pima, Santa Cruz and Cochise Counties of Arizona.

Respectfully submitted, I am

Sincerely yours,

A. Blake Brophy

A. Blake Brophy
General Partner
Babocomari Ranch Company

ABB
Encl. (2)

A. Blake Brophy
[redacted]
TUCSON, AZ 85716

Rec'd 5-31-83

May 27, 1983

Richard A. Mascolo
Chief, FAA, Wine and Beer Branch
Bureau of Alcohol, Tobacco and Firearms
Department of the Treasury
Washington, D.C. 20226

Dear Mr. Mascolo:

I am pleased that I am able to answer your questions that you asked of me in your letter of May 11, 1983, and I shall proceed to do so.

1) The total current commercial vineyard acreage in the area is approximately 40 acres.

2) The total additional planned commercial vineyard acreage in the area is: a) the present growers on the San Ignacio del Babocomari plan to expand to 120 acres; b) the Babocomari Ranch Company plans for the future call for 200 acres; c) known plans for outside the boundaries of the San Ignacio del Babocomari call for approximately 40 acres.

3) The locations on the U.S.G.S. maps of the current and planned commercial vineyards are marked in red on the composite map and are: #1 site of the current growers; #2 site of the Babocomari Ranch Company acreage; #4 and #5 sites for planned future vineyards.

4) The experimental vineyard referred to in the previously enclosed article is marked on the composite map in red #3.

5) The winery, which is in construction at this time, is located in vineyard site #1 and is marked with a red X.

6) The current commercial vineyards are in their fifth leaf this growing season.

7) There is no evidence that the term "Sonoita Basin" has been used to describe the area to which the petition relates. I consulted the Arizona Historical Society and the Tucson office of the U.S.G.S., and they both concluded that no name or term has been accepted for the area designated in the petition. AND THIS BECOMES THE POINT: I took it upon myself to introduce the term "Basin" to the Sonoita area, because I am aware of current geological terminology. Since first writing you, however, and after discussing the terminology with numerous knowledgeable persons in the wine business, I have come to the conclusion that "Basin" is one of the least desireable words to use for designating the area. It has met almost unanimous disapproval for its marketing connotations. I, therefore, request that you drop "Basin" from the designation, and merely use Sonoita Viticultural Area as the designation.

The reasons for using "Sonoita" to designate the area were presented to you in my original letter of petition. The community of Sonoita is also the site of the Santa Cruz County Fair, Nogales being the county seat.

8) The revised dates of each of the U.S.G.S. maps used in the composite map included with the petition, and herewith returned to you, are 1958.

9) The only vineyard to the petitioners knowledge, actual or planned, outside the proposed area but near it, is marked in red as #6 and it is still in the planning stage.

I do hope that these answers to your questions will be helpful to you.

Very Sincerely Yours,

A. Blake Brophy

A. Blake Brophy
General Partner
Babocomari Ranch Company

THE USE OF SOILS FOR THE DELINEATION OF VITICULTURAL ZONES IN THE FOUR CORNERS REGION

Gordon R. Dutt, Eugene A. Mielke, Wade H. Wolfe

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ABSTRACT

Delineation of viticultural zones has been useful in making varietal recommendations and predicting wine quality. The California base 50 growing-degree-day model fails to predict zones in the Four Corners Region which are comparable to California, either in adaptable varieties, sugar and acid or color of red varieties. A new model has been developed based on modern soil surveys and altitude. The soil parameter most useful in describing viticultural adaptability is the mean annual soil temperature at 50 cm. This parameter subdivides soils into hyperthermic, thermic and messic. Most wine grapes in California are produced on thermic soils, hence, this soil group has been subdivided. Altitude (inter-related to temperature) is the secondary parameter. Zones defined are HT (hypothermic), T_l (low-level thermic), T_m (mid-level thermic), T_h (high-level thermic), and M (messic). This system while encompassing the G.D.D. concept, allows for wider climatic conditions to be considered.

The first problems facing prospective growers in new areas being developed for grape production is site and variety selection. To aid in these selections it has been found convenient to develop viticultural zones. The procedure of Amerine and Winkler (1) led to the development of five viticultural zones used with marked success for establishing wine grape vineyards in California. The procedure followed was; a) quantatizing grape must and wine qualify by chemical and sensory procedures; b) establishing research vineyards containing varieties of interest; c) quantitatively evaluating the grapes and wines for each variety at each of the vineyard sites, d) developing functional relations between climatic variables and quality perimeters and e) developing a model based on the findings to determine viticultural zones. Of the variables studied only temperature was found to affect quality. The temperature parameter used was the 50 F base degree-day in their functional relationships. The five zones (Zones I through V) were defined in terms of summations of degree days between April 1 and October 31. Total acid, and color in red wines decreased as plantings proceeded from Zone I to V. The best varieties based on wine quality were selected for each of the defined zones.

Conflicting opinions exist concerning the effect of soils on grapes. Some writers have attributed much of the distinctive difference in wine quality to soils while others considered the soil as simply anchoring media which stores nutrients and water (3). The latter group attributes the distinctiveness of wines to climate. However, soils are in themselves a product of climate. Soils developed from the same parent material under differing climatic conditions are as distinctively different as the wines produced from grapes grown on them.

Soils, like plants and animals, have distinctive characteristics which may be recognized and determined by visual, chemical and physical means. Soil characteristics are used to distinguish individual soil series, just as plant properties are used to identify individual plant varieties. In soils, differing characteristics are due to five soil forming factors: a) parent material, e.g., sandstone, basic igneous rock, marine sediments; b) climate; c) topography; d) living organisms (plant and microbiological); and e) time.

Soils are an integration of these soil forming factors. These manifest themselves into visual and chemical properties which can be seen or determined. These soil properties are in turn used to classify soils. The classification system currently used in the United States (12) has six categories or classification levels referred to as: order, suborder, great group, subgroup, family, and series. The *order* is the most general classification and the *series* the most specific.

Within the California viticultural zones soil series have been used to locate sites for the production of grapes (13). However, the soils nomenclature now in use was not yet developed when the California based growing degree day viticultural zone system (1) was adopted.

Preliminary work conducted in Arizona (5) indicated good acid and color were attained in a vineyard considered to be a high Zone V. Similar observations were reported by growers in the Four Corners Region. With this in mind, the following study was conducted to develop viticultural zones for the Four Corners Region, i.e., Arizona, Colorado, New Mexico and Utah.

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MATERIALS AND METHODS

Experimental vineyards were established near Dateland, Tucson, Orcale and Sonoita, Arizona; Albuquerque, Lincoln, Roswell, Farmington, and Placitas, New Mexico; Grand Junction, Paonia, Colorado; and Blanding, Bluff Bench, Moab and St. George, Utah. At maturity grapes were harvested and air lifted to an experimental winery at the University of Arizona, Tucson. The grapes were processed through a stemmer-crusher, and the resulting must analyzed for sugar, pH and total acid (2). The must was processed into wine (9). Wines were analyzed for free SO_2, volatile acidity, percent alcohol, pH, total acidity, residual sugar, extract, tannin, and color by standard methods (2). A taste panel consisting of at least 6 members analyzed the wines blind using the 20 point Davis system (11). Commercial California wines were included in the blind tasting as controls. Climatological and soil data were obtained for each site.

RESULTS AND DISCUSSION

The base 50 F degree-days for several Four Corners locations are shown in Table 1. According to the grape degree-day, G.D.D., system, the coolest site, Grand Junction, is a Region III. The only *vinifera* grapes which produce consistently are White Riesling, Chardonnay, and Pinot noir (recommended for Regions I and II); French hybrids also do well. Carbernet Sauvignon usually suffers winter damage, Pinot noir fails to color sufficiently, and Napa Gamay fails to mature (excessive acid). Other than these problems, wines from Grand Junction tend to be balanced with good varietal character (9). Grape varieties adaptable to the site are not the ones expected to do well according to California's recommendations (14).

The next warmest site, Albuquerque, averages 3611 degree days and is a Region IV by the G.D.D. system. However, *vinifera* winter kill, and only French hybrids bear consistent crops. Perhaps the hardiest *vinifera* varieties, such as White Riesling and Pinot noir, could survive at the most favored sites. Again, California's recommendations provide little value for proper variety selection at this location. St. George with 4807 G.D.D. is a Region V. Fruit analyses here agree with the California system in that grapes are usually low in acid (0.5 to 0.6 g/100 ml), have high pH's (3.4 to 3.8) and produce red wines inadequately colored.

Table 1. 50 F Degree days at several vineyard sites in the Four Corners Region.

Dateland	7148
Tucson	5581
Page Ranch, Oracle	5325
Sonoita	4918
St. George	4807
Albuquerque	3611
Grand Junction	3400

The next two locations, Sonoita and Oracle, are both Region V's with 4918 and 5325 G.D.D., respectively. Musts from Sonoita have moderate to high acidity (0.7 to 1.0 g/100 ml), pH's between 3.1 and 3.6, and produce highly pigmented red wines. Fruit from Oracle (see

Table 2. Must analysis for Oracle — 1979.

Variety	Harvest Date	Yield kg/Vine	Brix	pH	Total Acid G/100 ml
Barbera	Aug. 29	8.71	24	3.2	1.09
Cabernet Sauvignon	Aug. 27	3.05	25	3.6	0.72
Colombard	Aug. 18	3.16	23	3.30	0.92
Ruby Cabernet	Aug. 28	3.11	24	3.6	0.68
Sauvignon blanc	Aug. 21	5.01	23.0	3.55	0.68
White Riesling	Aug. 28	3.50	22.0	3.35	0.81
Chenin blanc	Aug. 27	5.68	25.8	3.7	0.66
Zinfandel	Aug. 23	4.24	21.2	3.4	0.64

Table 2 for 1979 data) has moderate acidity, pH, and good color. Must values for both sites depart from what one would expect in a Region V from California's experience. The only indication of the high G.D.D. is early harvest dates (e.g. mid to late August at Oracle).

The must analyses from Tucson are nearly identical to those from St. George. The Dateland site, with over 7000 G.D.D., produces musts with low acidity, high pH's and low color in agreement with California's data.

From these data it is concluded that there are several inconsistencies between observed fruit quality and that predicted from California's G.D.D. system. Although Tucson, St. George, and Dateland conform to this system, other sites such as Sonoita and Oracle produce much better fruit than would be expected. In addition, Grand Junction and Albuquerque, which have moderate to warm growing seasons suited to wine grapes, suffer extreme winters that restrict the cultivation of *vinifera* varieties. They are forced to grow the hardiest *vinifera* (e.g. White Riesling) or French hybrids (e.g. Chancellor and Syval blanc). Winter hardness is not considered in the California recommendations because of mild winters. It is, therefore, proposed that an alternative system based on soil be used to predict site suitability for both quality and vine survival. Soil characteristics were chosen because they reflect both the intrinsic properties of the soil, such as base material, and past weather conditions through minearlization. Such a system would therefore incorporate both soil and climatic conditions in predicting site suitability (quality and survival) for wine grapes.

Soils: Soils series used for grape production in California, which have been classified using the current classification system, may be found in recently published soil surveys (6, 7, 8, 10). Complete soil names for these and other series may be found in classification of Soil Series of the United States (4). Names for some California soils used for grape production are given in Tables 3 and 4, and those for the Ste. Michele vineyards in Washington are given in Table 5. Those for the experimental plots are shown in Table 6. The soil's name (12) is made up of the soil series, the family name and finally the subgroup name. The subgroup name is in turn made up of formative elements starting from the end of the subgroup name which gives the order, suborder, great group, and subgroup.

The system of nomenclature in Soil Taxonomy might seem meaningless to someone first encountering it, but once a person learns the logic of it and how the formative

Table 3. Soils used for grape production southern California.

Series	Family	Sub-Group	County
Atwater	Coarse-loamy, mixed, thermic	Typic Haploxeralfs	Fresno
Borden	Fine-loamy, mixed, thermic	Typic Haploxeralfs	Fresno
Exeter	Fine-loamy, mixed, thermic	Typic Durixeralfs	Fresno
Grangeville	Coarse-loamy, mixed, thermic	Fluvaquentic Haploxerolls	Fresno
Hanford	Coarse-loamy, mixed, non-acid, thermic	Typic Xerorthents	Fresno
Hesperia	Coarse-loamy, mixed, non-acid, thermic	Xeric Torriorthents	Fresno
Madera	Fine, montmorillonite, thermic	Typic Durixeralfs	Fresno
Pachappa	Coarse-loamy, mixed, thermic	Mollic Haploxeralfs	Fresno
Delhi	Mixed, thermic	Typic Xeropsamments	Riverside
Hanford	Coarse-loamy, mixed, non-acid, thermic	Typic Xerorthents	Riverside
Hilmar	Sandy over loam, mixed (calcareous), thermic	Aeric Halaquents	Riverside
Tujunga	Mixed, thermic	Typic Xeropsamments	Riverside

Table 4. Soils used for grape production northern California.

Series	Family	Sub-Group	County
Bale	Fine-loamy, mixed, thermic	Cumulic Ultic Haploxerolls	Napa
Cole	Fine, mixed, thermic	Pachic Argixerolls	Napa, Sonoma
Coombs	Fine-loamy, mixed, thermic	Ultic Haploxeralfs	Napa
Cortina	Loamy-skeletal, mixed, non-acedic, thermic	Typic Xerofluvents	Napa, Sonoma
Haire	Clayey, mixed, thermic	Typic Haploxerults	Napa, Sonoma
Perkins	Fine-loamy, mixed, thermic	Mollic Haploxeralfs	Napa
Pleasanton	Fine-loamy, mixed, thermic	Mollic Haploxeralfs	Napa, Sonoma
Tehame	Fine-silty, mixed, thermic	Typic Haploxeralfs	Napa
Yolo	Fine-silty, mixed, non-acedic, thermic	Typic Xerorthents	Napa, Sonoma
Arbuckle	Fine-loamy, mixed, thermic	Typic Haploxeralfs	Sonoma
Clough	Clayey-skeletal, kaolinitic, thermic	Abruptic Durixeralfs	Sonoma
Goldridge	Fine-loamy, mixed, mesic	Typic Haploxerults	Sonoma
Huichica	Fine-loamy, mixed, thermic	Abruptic Haplic Durixeralfs	Sonoma
Red Hill	Fine-loamy, mixed, mesic	Ultic Palexerolls	Sonoma
Sebastopol	Clayey mixed, mesic	Typic Haploxerults	Sonoma
Wright	Fine, mixed, mesic	Mollic Albaqualfs	Sonoma

Table 5. Soils used for grape production in Washington.

Series	Family	Sub-Group	Location
Burke	Coarse-silty, mixed, mesic	Xerollic Durorthids	Grandview, WA
Hezel	Sandy over loam, mixed, non-acid, mesic	Xeric Torriorthents	Grandview, WA
Koehler	Sandy, mixed, mesic	Xerollic Durorthids	Grandview, WA
Prosser	Coarse-loamy, mixed, mesic	Xerollic Camborthids	Grandview, WA
Quincy	Mixed, mesic	Xeric Torripsamments	Grandview, WA
Sagehill	Coarse-loamy, mixed, mesic	Xerollic Camborthids	Grandview, WA
Sagemoor	Coarse-silty, mixed, mesic	Xerollic Camborthids	Grandview, WA
Shano	Coarse-silty, mixed, mesic	Xerollic Camborthids	Grandview, WA
Warden	Coarse-silty, mixed, mesic	Xerollic Camborthids	Grandview, WA

Table 6. Soils used for experimental plots in the Four Corners Region.

Series	Family	Sub-Group	Location
Gila	Coarse-loamy, mixed (calcareous), thermic	Typic Torrifluvent	Albuquerque, NM Tucson, AZ
Tremont	Fine-loamy, mixed, hyperthermic	Typic Haplargids	Dateland, AZ
White House	Fine, mixed, thermic	Ustollic Haplargids	Sonoita, AZ Oracle, AZ
Billings	Fine-silty, mixed (calcareous), mesic	Typic Torrifluvents	Grand Junction, CO
Mayfield	Fine-loamy, carbonatic, mesic	Xeric Torrifluvents	Grand Junction, CO
Mesa	Fine-loamy, mixed, mesic	Typic Haplargids	Grand Junction, CO
Doak	Fine-loamy, mixed, mesic	Typic Haplargids	Farmington, NM
Gabaldon	Fine-silty, mixed, mesic	Cumulic Haplustolls	Lincoln, NM
Reakor	Fine-silty, mixed, thermic	Typic Calciorthids	Roswell, NM
Reeves	Fine-loamy, gypic, thermic	Typic Gypsiorthids	Roswell, NM
Vinton	Sandy-mixed, thermic	Typic Torrifluvents	Albuquerque, NM
Ackmen	Fine-silty, mixed, mesic	Cumulic Haplustolls	Montezuma Canyon, UT
Leeds	Fine-loamy, mixed (calcareous), thermic	Typic Torrifluvents	St. George, UT
St. George	Coarse-silty, mixed (calcareous), thermic)	Typic Torrifluvents	St. George, UT

elements fit together and reflect different soil properties then it becomes quite useful.

As the details of the classification system are very extensive, this discussion will be limited to those names which are of importance to grape and wine production.

Order: Of the 10 different orders recognized, only five (Entisols, Aridsols, Alfisols, Mollisols and Ultisols) are used extensively for the production of grapes.

Entisols: This order includes soils which show only very limited profile development. They are commonly found on valley floors, where they have formed in recent deposits of alluvium or wind blown materials. These soils are frequently deep, fertile, usually low in organic matter but high in base saturation. Slopes are usually 0 to 2%. These soils are usually irrigated in the western United States if water is available. When planted to grapes, high production occurs. Overproduction is frequently encountered, but can be controlled by pruning. Where there are perennial streams, high water tables may be encountered. Air drainage is usually poor, thus both late spring frost and winterkill may be encountered.

In California, Entisols are utilized for wine grape production in most wine producing areas of the state. These soils are known more for their high production than exceptionally high quality. Protection from spring frosts is frequently provided in the northern areas. In Washington, Entisols are usually avoided because of winterkill problem. Formative elements are used in the nomenclature for orders. The formative element for the Entisols is *ent*.

Aridisols; These soils are light in color and low in organic matter. A few of these soils have been used for production of table grapes in Arizona and California and wine grapes in Washington. They usually occur on the sloping planes near the mountains and are low in natural fertility. The extent of weathering varies with the degree of profile development, but in general they are more weathered and developed than Entisols. Irrigation is normally required for the production of grapes. Cropping levels can be easily controlled on the soils because of their low fertility. These soils may be shallow and contain high sodium, soluble salts, gypsum and excessive lime. Any of these latter conditions would cause problems with vineyards. The formative element of the Aridisols is *id*.

Alfisols; California's wine grape areas are planted to a large extent on soils classified as belonging to this order. These soils are found in higher rainfall areas than the Aridisols and consequently are more highly weathered. Like many of the Aridisols, they contain an argillic horizon, a layer enriched in clay just below the surface. However, the Alfisols are more highly weathered and leached of basic minerals. As with Aridisols, these soils frequently occur on slopes with good air drainage and are low in fertility. Whereas the Aridisols are usually basic in reaction, Alfisols are commonly acidic. Due to their low fertility, cropping levels may be easily controlled, and consequently the quality of wines produced from these grapes is high. The formative element of the Alfisols is *alf*.

Ultisols; These soils are more highly leached than the Alfisols. They commonly have a red subsoil and are more acid in reaction than the Alfisols. A few bordering on Alfisols or ones developed under somewhat dry conditions are used for the production of wine grapes in California. The formative element of the Ultisols is *ult*.

Mollisols; A few soil series used for the production of wine grapes in California are Mollisols. Although the number of these series is limited, they are particularly important in the cool coastal valleys. These soils, mostly formed under grass cover, are usually high in organic matter and basic constituents. The dark organic matter-rich surface layer is referred to as a *mollic epipedon*. Most soils of this order are found in climates adverse to grape production. However, at fringe areas, where these soils are adjacent to Aridisols or Alfisols, they can be used for production of quality wine grapes. In these fringe areas, the content of organic matter in the mollic epipedon would be at the low end for Mollisols. The formative element is *oll*.

Suborder and Great Group: Soil orders are further subdivided. Only a few of these subdivisions seem to be important to grape production. Some of the important suborder and great group formative elements and their significance are:

Fluv: Suborders containing this formative element (Fluvents) designate soils in a floodplain. As they are in the lowest part of the drainage, they may be susceptible to flooding, high water tables, winterkill, and spring frosts. Vines usually are very productive.

Arg: Soils with this formative element in their names contain argillic horizons. This is usually an accumulation of clay which was leached from the overlying material. These horizons are frequently red and are associated with areas of quality wine production.

Torr: Soils formed in a dry climate contain this formative element in their names. Since vinifera grapes are susceptible to many plant diseases under humid conditions, designation of dry conditions for soil development is important for orders other than Aridisol, i.e., desert soils.

Xer: This element indicating suborders shows that the soil has a climate which includes winter precipitation and a long dry summer. This form is important for plant disease consideration.

Ust: Soils with this formative element have a rainfall higher than Torr in which a portion comes during the growing season. Also important for plant disease considerations.

Calc: This indicates the soil has a calcic horizon, i.e., a layer of 15% calcium, carbonate or lime. The presence of high lime is often responsible for micronutrient deficiencies and can limit the cultivation of some or all grape varieties. In general, American varieties (e.g. Concord) are most sensitive to lime, French hybrids (e.g. Chancellor) are of intermediate sensitivity, and *vinifera* are least sensitive. If rootstocks are required to combat soil borne pests, such as phylloxera or nematodes, lime tolerant stock are necessary. Tolerant stocks include those with *Vitis berlandieri* (e.g. Oppenheimer Selection #4, Teleki 5A) or *V. champini* (Dog Ridge, Ramsey) parentage.

Dur: Soil contains a duripan (silica cemented hardpan) which may significantly restrict root growth.

Hapl: Weakly developed horizon. Restriction of root penetration or water flow would not be adverse.

Subgroup: Indicates whether a soil tends toward or is borderline to other soil orders, suborders or great groups. The formative elements of the above are utilized along with the suffix ic in these borderline cases. If the soil is central to the name subdivision, the formative element Typic is used.

Family: Probably the most useful part of the soil name from a grape grower's point of view is the family name. This portion of the name gives information on the soil texture, clay minerals and temperature. Grapes are grown successfully on most textural classes and most soils used for grape production tend to be of a mixed mineralogy. The temperature consideration, however, seems to be one of the more important factors. The system used in evaluating the temperature regime of a soil is dependent on the mean annual temperature at a 50 cm depth. The formative elements and their temperature ranges are:

Frigid	$<$8C or $<$47F
Mesic	8 to 15C or 47 to 59F
Thermic	$>$15 to 22C or $>$59 to 72F
Hyperthermic	$>$22C or $>$72F

Hyperthermic: Hyperthermic soils occur in California where grapes are grown principally in the Imperial and Coachella Valley. In these areas grape production is usually limited to table grapes for the early market. In the Four Corners Region, hyperthermic soils occur in southwestern Arizona. As in California, production of grapes is now limited to table varieties.

Thermic: Thermic soils are the most important soils for the production of wine grapes in California. These soils may be found from Riverside to Napa and Sonoma counties. It is within this soil grouping that the University of California grape zone classification system is principally used. It is of interest that the interface area between thermic and mesic, the next coldest region, is located in Napa, Sonoma, and Amador counties. Both table and wine grapes are grown on soils of this family.

Mesic: Grapes are successfully produced on warmer locations found in mesic soil areas. Some of the best wine grapes in California are produced on these soils. As one proceeds away from the thermic-mesic interface, problems of spring frost and winterkill increase. Washington wine grape industry is located principally on mesic soils.

As an example of how soil names are formulated, consider the White House soil series: It is dry most of the time and has a light-colored epipedon or surface so that it qualifies as Aridisol.

Order — Ar*id*isol: Formative element, id
Further: it has subsurface clay layer that has been formed by migration of clay downward (an *arg*illic horizon, formative element, arg).

Suborder — Argid
Further: The subsurface layer contains only enough clay to qualify as an argillic horizon (a minimum number of horizons, formative element, hapl).

Great Group — Haplargid
Further: It has a dry climate but with some summer rain; formative element, ust. The soil borderlines the order Mollisol, hence has properties similar to the order Mollisol, formative element, oll.

Subgroup — Ustollic Haplargid
Further: The family name precedes the subgroup name and consists of three parts: 1) the texture of the control horizon, 2) the clay mineral present, and 3) the mean soil temperature as outlined previously. Thus, for our White House soil, the texture of the argillic or control section is fairly high or high in clay, hence it is called fine. The clay consists of a mixture of minerals and the temperature of the soil falls closest to the thermic group, thus the full name:

Name — White House — fine, mixed, thermic, Ustollic Haplargid

It is concluded: 1) Soils considered for table and wine grape production for heavy producing varieties should be deep, with good drainage, have little soil development, (entisols) or weak argillic or mollic horizons with low organic matter, have a dry climate and have temperatures placing them in the hyperthermic or thermic temperature range; 2) Soils considered for the production of premium wine grape varieties should be highly weathered, have an argillic or weak mollic epipedon, have a dry climate, with adequate cold air drainage, and be on the cooler regions of soil belonging to the thermic family or warmer areas of soils belonging to the mesic family.

Delineation of grape-growing areas: As previously mentioned, grapes are grown on soils belonging to the hyperthermic, thermic, and mesic families. Of particular importance is what varieties may be grown on these soils to produce grapes in sufficient quantities to produce quality wines. To aid in these selections, the establishment of viticultural areas within the Four Corners Region seemed advisable. On the basis of viticultural, enological climate and soil date, five viticultural districts were developed: HT, T_l, T_m, T_h, M. See Figure 1.

HT: These viticultural areas are found in the low valleys of southwestern Arizona. They are areas where table grape production for early markets has been profitable. Wine grapes can be grown for the production of mainly white table and desert wines. The site in this area, studied over the past years was at the Whitewing Range near Dateland, Arizona; analyses of wine grapes from the study have been previously reported (9).

T_l: Viticulture areas so designated are found on thermic soil at elevations below 900 meters. The characteristics of grapes grown on thermic soil varied so widely that they were subdivided for making varietal recommendations. Since altitude is closely related to soil temperature in the Four Corners Region (9), it was chosen as a convenient means for subdividing the ther-

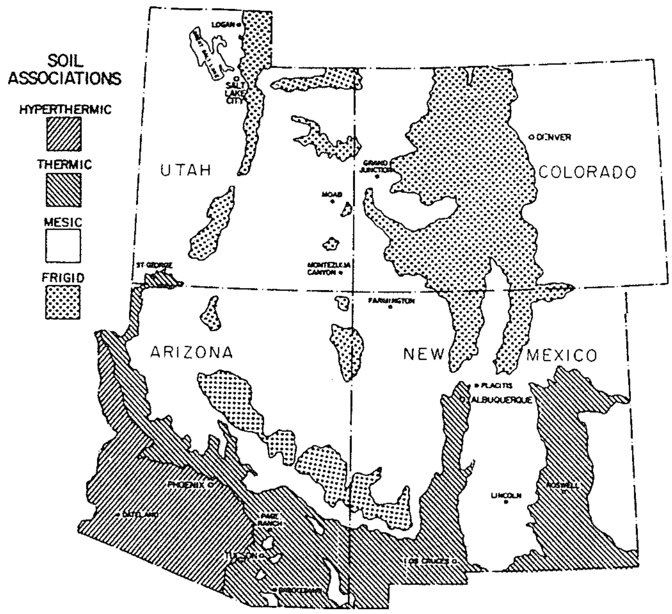

Fig. 1. Soil associations map of the Four Corners Region.

mic soils. In the Four Corners Region the T_l areas are thermic soils below 900 meters. T_l sites where grapes and wines were evaluated include St. George, Utah and Tucson, Arizona.

T_m: These areas are found on mid-altitude, thermic soils. Altitudes range from 900 to 1200 m. Entisols in low-lying valleys could be expected to have moderate to severe problems with late springs frosts. Frost protection would seem advisable in all low-lying areas. Sites that were studied include Rosewell, New Mexico and The University of Arizona Page Ranch at Oracle.

T_h: These thermic soils are found at altitudes above 1200 m, on hillside area where good air drainage exists. Entisols in low-lying valleys would be uneconomical for the production of vinifera wine grapes, due to spring frosts and winterkill. Sites studied included Sonoita, Arizona and Albuquerque, New Mexico.

M: Mesic soils that border on thermic soils are capable of producing premium quality white wines from vinifera grapes. In these areas frost and winterkill are a problem with even the most cold-resistant *vinifera*. In addition the growing season is too short for many vinifera red grapes. Red and white wines of high quality can be produced from French hybrid grapes. Sites which were evaluated include Lincoln, Placitas, and Farmington, New Mexico; Moab, Bluff Bench, and Blanding, Utah; and Grand Junction, Colorado.

Table 7. Total acid (g/100 ml tartaric) musts from the Four Corners Grape Regions.

Variety	HT	T_l	T_m	T_h	M
Barbera	.62	.7	1.01	1.10	N
Cabernet Sauvignon	N	.58	.74	.75	.87
Chardonnay	.54	.58	.79	1.06	.94
Pinot Noir	.48	.51	.70	.86	.81
Zinfandel	.61	.56	.80	.89	1.10

Table 8. Color intensity (420 mm + 520 mm) of wines from the Four Corners' viticultural regions.

Variety	HT	T_l	T_m	T_h	M
Ruby Cabernet	.273	.440	.515	.707	N
Pinot Noir	.270	.260	.342	.360	.198
Cabernet Sauvignon	N	.354	.492	.536	.527
Barbera	.213	.325	.452	.398	N
Zinfandel	.231	.334	.337	.330	.294

The relationship between the total acid for several varieties and the Four Corners Grape Region is shown in Table 7. Also, the relationship between the viticultural regions and color are shown in Table 8. It is concluded that total acid of musts and color intensity of wines is a function of the mean soil temperature, and that viticultural zones established for varietal recommendations can be established on the basis of these mean temperatures. On this basis and on production and enological evaluations (9), the tentative recommendations for the Four Corners sites shown in Table 9 are made.

Table 9. Recommended grape varieties for the Four Corners.

1. *Hyperthermic, HT*
   - Emerald Riesling
   - French Colombard
   - Malvasia bianca
   - Petite Sirah
2. Thermic low, T_l
   - Barbera
   - Carignane
   - Carnelian*
   - Emerald Riesling
   - French Colombard
   - Malavasia bianca
   - Petite Sirah
3. Thermic medium, T_m
   - Barbera
   - Cabernet Sauvignon
   - Carnelian*
   - Chardonnay
   - Chenin blanc
   - French Colombard
   - Gamay (Napa)
   - Ruby Cabernet
   - Sauvignon blanc
   - Semillon*
   - Sylvaner
   - White Riesling
   - Zinfandel
4. Thermic-high, T_h
   - Barbera
   - Cabernet Sauvignon
   - Carmine*
   - Chardonnay
   - Chenin blanc
   - Pinot noir

   Th cont'd
   - Ruby Cabernet*
   - Sauvignon blanc
   - Semillon
   - Sylvaner
   - White Riesling

   French hybrids
   - Cascade
   - Chancellor*
   - Cehlois*
   - DeChaunac*
   - Foch
   - Seyval blanc*
   - Verdelet*
   - Vidal blanc*
   - Villard blanc*
5. Mesic M
   - Chardonnay**
   - Gewurztraminer*
   - Pinot noir**
   - White Riesling

   French hybrids
   - Chancellor*
   - Chelois*
   - DeChaunac*
   - Foch
   - Seyval blanc
   - Vidal blanc*
   - Villard Blanc

   American hybrid
   - Delaware
   - Himrod

* Qualified Recommendation. Varieties not tested but predict good performance based on similar varieties.
** Qualified recommendation. Probable winter hardiness problems unless in best sites and/or with optimum cultural practices.

It is speculated that other terms in the subgroup name can be further used to further subdivide and make improved varietal recommendations.

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THE DESERT GRASSLAND

A History of Vegetational Change and an Analysis of Causes

ROBERT R. HUMPHREY

THE UNIVERSITY OF ARIZONA PRESS

[1968]

Arizona's First Farm Wine Release

*By Thomas A. Brady, Jr.**

Dr. Gordon Dutt pioneers Vinifera and designs a new model for vineyard site selection.—Ed.

The first commercial farm winery in Arizona is due to release its initial bottling, a 1983 wood-aged Fumé Blanc, in May 1984. Sonoita Vineyards is owned by Dr. Gordon Dutt, and managed by his son Rocky. Dr. Dutt, a soil scientiest with the University of Arizona in Tucson, traces the origins of his vineyard to a University sponsored water harvesting project which he headed.

The water conservation research was aimed at watering crops solely from rainfall using contours and terraces. Dr. Dutt had studied irrigation techniques at U.C. Davis and was familiar with the limited water requirements of wine grapes. It was found that grapes require half the water per acre as some of Arizona's traditional crops like cotton and alfalfa. More important was the surprisingly consistent high calibre of the Vinifera vines involved in the study which was in a Zone V according to the California base 50 growing-degree-day model (G.D.D.).

In 1974 the first of several university experimental vineyards was planted around Tucson to determine the feasibility of winegrowing in Arizona. Other sites were soon planted across the state including one on the Babocomari Ranch 50 miles southeast of Tucson, near the town of Sonoita. About the time the vineyards came into production, funds were made available by the Four Corners Regional Commission to build a university winery to evaluate the potential of wines grown in Arizona, Utah, New Mexico and Colorado.

NEW SITE MODEL

Perhaps the most significant result of this on-going study has been the development of a new model for delineation of viticultural zones. It was found that a model based on soil surveys and altitude, while at the same time incorporating the G.D.D., allowed for wider climatic conditions to be evaluated in making varietal recommendations and predicting wine quality.

In 1978 Dr. Dutt acquired land near the Babocomari experimental vineyard, and planted the first of his 20 acres. The primary soil association around Sonoita is Bernardino-White House-Hathaway. These soils are more than 60 inches deep on slopes ranging from 0 to 10 degrees. Vegetation is mainly perennial grasses and forbs. The best vineyard sites are at elevations between 4,000 and 5,000 feet. Average annual precipitation is up to 20 inches, and the mean annual temperature is around 60°F. The frost free season is 200 days. Runoff is slow and the hazard of erosion is slight. The soils have moderate to

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high available water capacity and historically the land has been used for grazing livestock and wildlife. The area is classified as "high desert grassland" and is surrounded on all sides by mountains which are part of the Coronado National Forest.

Dr. Adrian Boseman and John Harvey in 1979 were drawn to the Sonoita area by Dr. Dutt's experience and planted the beginnings of a 17 acre vineyard on land adjacent to Sonoita Vineyards. The group helped organize a winegrowers association which in 1981 sponsored a farm winery bill which was passed. In 1983 they constructed a winery together which was completed in time for a small crush. Expansion plans call for an additional 40 acres.

VINIFERA ON OWN ROOTS

Dr. Dutt's vineyard is planted on contours to preserve rain water. A trickle irrigation system is employed with a cordon trained and cane pruned two-wire trellis. The Vinifera vines are planted on their own roots even though Texas root rot is a concern. The theory is that the high altitude and slightly acid soil will provide adequate protection. The 1984 crush in Sonoita is expected to produce 3,000 gallons of wine mainly from Chenin Blanc, Sauvignon Blanc and Cabernet Sauvignon vines.

The vineyards and winery are located near Tucson and Phoenix in a popular historic setting. The area was first explored in 1539 by Fray Marcos de Niza, a Franciscan, whose fanciful report of finding the mythical Seven Cities of Cibola soon brought Francisco Vasquez de Coronado to the land looking for wealth and glory. The first real settlement by non-Indians came in 1691 when Padre Eusebio Francisco Kino, a Jesuit missionary-explorer established a **visita** for the Sobaipuri Indians. The **visita** was called Los Santos Reyes de Sonoita. The area was slow to develop, primarily because it was in the center of Apache controlled land. The Gadsden Purchase of 1853 secured this territory for the United States. The present town of Sonoita is in Santa Cruz Co. in the southeastern part of Arizona, bordered by Mexico on the South.

A petition for designation of an American viticultural area for Sonoita has been submitted by Mr. A. Blake Brophy, General Partner, Babocomari Ranch Company on whose lands the original university experimental vineyards were located. The boundaries of the region are formed by four highly visible and strategically located topographical features: Mount Wrightson Peak in the Santa Pita Mountains on the West, Lookout Knob in the Canelo Hills to the south, Huachuca Peak in the Huachuca Mountains toward the East, and Granite Peak in the Whetstone range to the North. The designated area includes approximately 100 square miles.

Bayleton Effective In Kentucky

Black rot pressure was high on grapes in Kentucky in 1983, however Bayleton provided "very good control", according to "Kentucky Fruit Facts," College of Agriculture, University of Kentucky, Lexington 40546.

of the owner's servants was treated the same way. Finally he sent his son (Jesus), thinking that surely they would respect him. But when they saw the son, "the tenants said to one another, 'This is the heir; come on, let us kill him, and get his inheritance.' And they flung him out of the vineyard and killed him."

The single most important symbolic use of the vine is found in John 15:1-10. This passage is an extended metaphor in which Jesus describes himself as a vine. "I am the real vine, and my Father is the vinedresser. Each barren branch of mine he cuts away; and every fruiting branch he cleans, to make it more fruitful still." This is a description of Jesus' relationship to his followers. Severe pruning is performed to keep the vine productive — the main point being that Christians must relate to Christ like good, strong canes to the trunk of the vine if they are to bear the fruit of faith; otherwise they will be pruned off and discarded. Unlike the eschatological vine of Baruch's description, which produces fantastic amounts of fruit, reference to the historical person Jesus keeps the image realistic; this "vine" is expected to perform within the normal limits of good viticulture. As a symbol of the church and Christ's relation to it, this would make a powerful impact in a sermon preached on this text, but only if we had more vineyards around and more clergy who grew up tending vines. So as I plant my vineyard out in Tates Creek Estates in Madison County and some Baptist deacon drives by and asks me what I'm planting all those grape vines for, I'm going to tell him it's so that the good church folk in this area will have a great deal more background for John 15:1-10. (I'll mention the wine later.)

Vines and vineyards are symbols not for insignificant, unimportant matters in the Bible but for the most central and most profound theological truths. They stand for the nation Israel, they stand for the spiritual life, and they stand for the Messiah. If the abuse by neglect that these passages of scripture have suffered from some religious people is due to their fear of talking too much about the source of wine, then "Repent, you sinners, and be ready to read subsequent articles in this series on wine in the Bible!" Meanwhile, it occurs to me that I should inquire of IRS about getting a deduction as a religious contribution for the cost of planting and maintaining my vineyard.

Arizona's First Short Course

"Principles of establishing small vineyards" by Keith Bowers, Farm Viticultural Advisor, Napa County, California, featured the first Wine Grape Short Course conducted by the Arizona Wine Growers' Association, February 24-25 at the University of Arizona, 2130 E. Allen Road, Tucson.

The non-profit organization will begin publication of a newsletter, edited by Tom Brady, Viticulture, Inc., 177 N. Church St., Suite 504, Tucson 85701.