

Vine environment interaction as a method for land viticultural evaluation. An experience in Friuli Venezia Giulia (N-E of Italy).

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INTRODUCTION

For a long time environment was known as one of the most important factors to characterize the quality of wines but at the same time it appears very difficult to distinguish inside the "terroir" the role of the single factor. These remarks partially explain why methods for viticultural evaluation are often quite different (Amerine *et al.*, 1944; Antoniazzi *et al.*, 1986; Asselin *et al.*, 1987; Astruc *et al.*, 1980; Bonfils, 1977; Boselli, 1991; Colugnati, 1990; Costantinescu, 1967; Costantini *et al.*, 1987; Dutt *et al.*, 1981; Falcetti *et al.*, 1992; Fregoni *et al.*, 1992; Hidalgo, 1980; Intrieri *et al.*, 1988; Laville, 1990; Morlat *et al.*, 1991; *Scienza et al.*, 1990; Shubert *et al.*, 1987; Turri *et al.*, 1991).

From the beginning of the 80s only, studies about adaptation of vine to environment finally acquired an interdisciplinary and complementary character. In this way, the definition of viticultural vocation rises from the interaction of informations on the climate, the geomorphology, soil conditions and cultural practices with vine-performance, drawing special attention to a relationship between climate, soil and vine.

Substantially, the "zonation" idea is connected with "viticultural vocation", where "zonation" means the subdivision of a land by ecological, pedological and topographical characteristics, verified by the adaptation of the different cultivars (Morlat *et al.*, 1989, 1991).

MATERIAL AND METHODS

The land subject of the present research is the AVA "Friuli GRAVE" area, located in Northeastern Italy (Friuli-Venezia Giulia region). This territory is divided by the spring-line in two parts called "Alta pianura" and "Bassa pianura". It borders in the North-West with the hilly and mountaneous zone, in the West and South with the Veneto region and in the East with the Tagliamento river.

Geologically, the area under study was formed during the last Würmian glaciation by rivers from the glaciers of the Tagliamento, the Meduna and Cellina rivers which were flowing into the plain. The "Alta Pianura" as well as the "Bassa Pianura" are characterized by floods of the recent Diluvial and the Alluvial; they are deposits where the calcareous-dolomitic components are predominant (Comel, 1934; Comel, 1950; Comel, 1956; Comel *et al.*, 1952).

Based on the Koppen classification, this area has a sub-continental temperate climate.

About the soils, the temperature regime is mesic and the moisture regime is udic.

1. Viticultural parameters.

The first step of research allowed to identify within this area 13 types of soils, representative of the pedological variability and viticultural situation of this territory. Within every type of soil one vineyard-guide formed by the seven more widespread cultivars (Merlot, Cabernet Franc, Cabernet Sauvignon, Tocai friulano, Pinot grigio, Chardonnay, Sauvignon) has been identified; afterwards these vineyards-guide represent the different pedological, agronomical and cultivation typologies of AVA "Friuli GRAVE" area.

All these vineyards present the same agronomical characteristics : age, growing system (Sylvoz system or Sylvoz modified Casarsa), bud load (55.000-60.000 buds/ha).

During the season a series of investigation of both physiological-vegetative parameters (phenological phases, yield, clusters per vine, weight of cluster, weight of pruned wood, Ravaz index) and must composition (titratable acidity, pH, total sugars) was carried out in order to test vine-environment interaction.

In the present paper we present the most significant data about yield composition.

2. Pedological parameters.

On every site where the vineyard-guide was situated, a soil profile was created by mechanically digging a rectangular trench large about 1 m and long about 2 m; the trench, after digging, was photographed. Subsequently identification, designation and delimitation of the horizons present in the profile were carried out. Soil samples were taken from each horizon and were later dried in the open and sieved at 2 mm in order to separate the skeleton from the fine earth on which laboratory analysis were effected. The data from the description of each profile were later collected in a card-index divided in two parts : the first part was about the characteristic features of the survey station while the second part described the mineral horizons. Each profile was classified according with the FAO-UNESCO methodology (1988) and the Soil Taxonomy (USDA, 1975).

RESULTS AND DISCUSSION

1. Pedological parameters.

The following pedological typologies were founded on the "Alta Pianura".

- Soils formed on pedogenetic substrates made of floods of coarse gravels from the Meduna and Cellina rivers dated to the recent Diluvial. These are moderately deep soils and which have a mollic epipedon (Phaeozems) and which are not calcareous from 20 to 50 cm of the surface (Haplic Phaeozems). (tabl.1 profile 3)

- Soils of pedogenetic substrates covered with gravel and dated recent Diluvial and moderately with a diagnostic cambic horizon not easily distinguishable. These soils are redish-brown coloured (Munsell, 1994) and calcareous on the surface layer (Calcaric Cambisols).

Soils formed on recent gravel floods, present even in the most depressed areas, close to rivers characterized by fine, sandy flood deposits. These soils are shallow, not too much evolved (Fluvisols), and have an abundant content of rock fragments, with a high content of carbonates even on the surface layers (Calcaric Fluvisols) (tabl. 2 profile 10). Their properties are attributed more to the methods of materials deposition than to pedogenesis phenomena.

he following peculiar features characterize the "Bassa Pianura"; some of these can be found in "Alta Pianura" too.

Soils formed on fine clayey nature floods deposited in more recent times on substrates of gravel. These are soils of moderate depth, with cambic horizon (Cambisols) and no carbonates; they are influenced by the water-bearing layer and show a gleyic properties within 100 cm of the surface (Gleyic Cambisols). (tabl.3 profile 9)

- Fine-textured soils with ochric epipedon and a calcic horizon, characterized by the presence of CaCO_3 (Haplic Calcisols).

- Soils of moderate depth, yellowish-brown coloured (Munsell, 1994), very calcareous and showing clear grey mottles within 50 cm from the surface (Gleyisols) and having a calcic horizon (Calcaric Gleyisols).

- Soils developed in proximity to rivers from recent flood deposits, prevalently gravelly; moving towards valley, there is an increase of finer elements such as sand and silt. These are soils with an high content of carbonates too (Calcaric Fluvisols).

2. Viticultural parameters.

First results about yield characteristics (tabl.4) show, in general, a trend exalting productive potential in vineyards-guide located in the southern part of AVA area (9,10,11); this index is strictly in relationship with number of clusters and then cluster weight.

Furthermore the display of phenological phases (tabl.5) shows that the environments more advanced exhibit higher yield potential too.

The main future aim of the researches plan will be exactly to draw attention to the relationships between vine and micro-environment where it's cultivated, establishing, at the same time, a hierarchy of values.

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SOIL PROFILE DESCRIPTION

Profile:	3
Sheet/Grid:	065050 CTR / Gauss-Boaga
Coord:	2345950 5109800
Location:	Dandolo (Maniago)
Survey Area:	Grave
Elevation:	219 m
Classification FAO :	Haplic Phaeozem
USDA :	Typic Hapludoll
Soil Climate :	udic mesic
Topography :	flat
Land Form :	alluvial plain
Element/Pos.:	terrace-intermediaire part
Slope :	0.7 - 2% concave
Land Use :	agriculture-crops: vine
Parent Material :	alluvium (Pleistocene)
Eff. Soil Depth :	50-100 cm
Rock Outcrops :	nil
Surface Staones :	common stones
Erosion:	nil
Drainage :	excessively; permeability: high
Watertable :	>150 cm
Horizon (depth) :	Morphological Description
Ap (0-35 cm)	Very dark brown (10YR 2/2) (moist); siltloam; dominant medium subrounde limestone fragments; very weak medium granular structure; friable (moist), commo very fine roots; non calcareous; field pH: 6.0, abrupt smooth boundary.
Bw (35-57 cm)	Very dark brown (10YR 2/2) (moist); siltloam; dominant medium subrounde limestone fragments; weak medium granular structure; friable (moist), man medium roots; non calcareous; field pH: 6.0, abrupt wavy boundary.
C1 (57-82 cm)	Pale brown (10YR 6/3) (moist); dominant medium subrounded limeston fragments; nil roots; strongly calcareous; field pH: 8.0, abrupt smooth boundary.
C2 (82-120 cm +)	Very pale brown (10YR 7/3) (moist); dominant medium subrounded limeston fragments; nil roots; strongly calcareous; field pH: 8.0.

Profile :	9
Sheet/Grid :	086060 CTR / Gauss-Boaga
Coord :	2350590 5090730
Location :	S. Giovanni di Casarsa (Casarsa)
Survey Area :	Grave
Elevation :	35 m
Classification FAO :	Gleyic Cambisol
USDA :	Aquic Eutrochrept
Soil Climate :	udic mesic
Topography :	flat
Land Form :	alluvial plain
Element/Pos.:	flood plain - intermediate part
Slope :	0.3 - 0.7 % concave
Land Use :	agriculture-crops: vine
Parent Material :	alluvium (Holocene) over alluvium (Pleistocene)
Eff. Soil Depth :	50-100 cm
Rock Outcrops :	nil
Surface Staones :	nil
Erosion :	nil
Drainage :	moderately well; permeability : moderate
Watertable :	> 150 cm
Horizon (depth) :	Morphological Description
Ap (0-5 cm)	Very dark grayish brown (10YR 3/2) (moist); clayloam; moderate coars granular structure; friable (moist), common fine roots; non calcareous; fiel pH 6.0, abrupt smooth boundary
Bw1 (5-30 cm)	Dark grayish brown (10YR 4/2) (moist); clayloam; moderate coars subangular prismatic structure; friable to firm (moist), few fine roots; no calcareous; field pH 6.0, clear smooth boundary.
Bw2 (30-54 cm)	Brown (10YR 4/3) (moist); clayloam; moderate coarse subangula prismatic structure; firm (moist), few fine roots; non calcareous; field pH 6.0 clear smooth boundary.
Bwg (54-76 cm)	Brown (10YR 5/3) (moist); many fine distinct gray (10YR 5/1) mottles clayloam; very few medium subrounded limestone fragments; moderat coarse subangular prismatic structure; firm (moist), very few fine roots non calcareous; field pH 7.0, abrupt smooth boundary.
BC (76-105 cm)	Pale brown (10YR 6/3) (moist); siltloam; abundant coarse subrounde limestone fragments; single grain structure; very friable (moist), very fe fine roots; strongly calcareous; abrupt smooth boundary.
2C (105-140 cm +)	Pale brown (10YR 6/3) (moist); sand; few medium subrounded limeston fragments; single grain structure; nil roots; strongly calcareous.

Profile : 10
 Sheet/Grid : 085120 CTR / Gauss-Boaga
 Coord : 2345950 5109800
 Location : Casali Morpugo (Pasiano di PN)
 Survey Area : Grave
 Elevation : 15 m

Classification FAO : Calcari-Fluvisol
 USDA : Aquic Udifluent

Soil Climate : udic mesic
 Topography : flat
 Land Form : alluvial plain
 Element/Pos.: flood plain-intermediate part
 Slope : 0.3 - 0.7 % concave
 Land Use : agriculture-crops: vine

Parent Material : alluvium (Holocene)
 Eff. Soil Depth : 50-100 cm
 Rock Outcrops : nil
 Surface Staones : nil
 Erosion : nil
 Drainage : moderately well;
 permeability: moderate
 Watertable : > 150 cm

Horizon (depth) :	Morphological Description
Ap1 (0-5 cm)	Brown (10YR 4/3) (moist); siltloam; moderate fine subangular prismatic structure; friable (moist), common very fine roots; strongly calcareous; field pH: 8.0, abrupt smooth boundary.
Ap2 (5-51 cm)	Dark yellowish brown (10YR 4/4) (moist); siltloam; moderate medium subangular prismatic structure; friable (moist), few very fine roots; strongly calcareous; field pH: 8.0, abrupt smooth boundary.
C1 (51-70 cm)	Yellowish brown (10YR 5/5) (moist); siltloam; very few medium subrounded limestone fragments; weak very fine subangular prismatic structure; friable (moist), very few very fine roots; strongly calcareous field pH: 8.0, abrupt wavy boundary.
C2 (70-85 cm)	Light brownish gray (10YR 6/2) (moist); many medium distinct clear yellowish brown (10YR 5/8) mottles; siltloam; few medium subrounded limestone fragments; very weak fine subangular prismatic structure; friable (moist), very few very fine roots; strongly calcareous; field pH 8.3, abrupt smooth boundary.
Ck (85-90 cm)	Very pale brown (10YR 8/2) (moist); common medium subrounded limestone fragments; discontinuous nodular weakly cemented by carbonates nil roots; extremely calcareous; abrupt smooth boundary.
2C1 (90-108 cm)	Yellowish brown (10YR 5/8) (moist); many coarse distinct light brownish gray (10YR 6/2) mottles; sand; single grain structure; strongly calcareous; abrupt smooth boundary.
2C2 (108-140 cm+)	Gray (10YR 6/1) (moist); common medium distinct brownish yellow (10YR 6/6) mottles; sand; single grain structure; nil roots; strongly calcareous.

cv: Merlot

location	yield	clusters per vine	weight cluster	pruned wood	Ravaz index
Forcate	5822,1 cd	49,2 c	118,069 b	852,6 d	7,42 bc
Sequals	3961,3 ef	52,4 bc	74,98 c	1186,8 bc	3,41 de
Barbeano	2290 g	44,2 cd	50,62 d	1304,8 b	1,77 e
S. Martino	3195 fg	26,2 e	122,61 b	290,8 e	12,72 a
S.Giovanni	8260,3 b	61,3 b	136,81 ab	1040,8 cd	8,35 b
Pasiano	6683,5 bc	77,9 a	85,63 c	1392,2 ab	5,00 cd
Palse	12382 a	83,4 a	148,61 a	1535,7 a	8,33 b
Vistorta	5012,1 de	36,4 d	138,47 ab	432 e	11,97 a

cv: Cabernet franc

location	yield	clusters per vine	weight cluster	pruned wood	Ravaz index
Forcate	778 f	23,2 bc	32,11 e	1064,7 de	0,72 d
S. Quirino	2013 def	22,5 bc	90,82 b	1584,6 bc	1,45 d
Dandolo	1830,4 def	28 b	64,67 cd	1324,1 cde	1,41 d
Sequals	3968,6 bc	44,3 a	87,06 b	1053,9 de	3,92 b
Barbeano	3070 cd	48,9 a	63,18 d	2748,2 a	1,21 d
S. Martino	2337,8 de	28,9 b	78,29 bc	1477,8 bcd	1,63 d
S.Giovanni	6468 a	48,3 a	132,46 a	2746,2 a	2,74 c
Pasiano	6259 a	47,2 a	132,05 a	1280 cde	5,10 a
Le Monde	4347,5 b	46,4 a	94,25 b	1379,1 cde	3,19 bc
Palse	2287 de	32 b	69,76 cd	1926,7 b	1,44 d
Vistorta	1306,5 ef	16,8 c	76,58 bcd	931,2 e	1,63 d

cv: Cabernet sauvignon

location	yield	clusters per vine	weight cluster	pruned wood	Ravaz index
Forcate	5893,5 bc	56,7 b	105,75 bc	1638,1 b	3,67 cd
S. Quirino	4587,5 d	44,3 c	104,72 bc	1538,1 bc	2,95 d
Dandolo	4506,7 d	50,7 bc	89,49 cd	1105,8 d	4,39 bc
S. Martino	5257 cd	55,5 bc	95,01 bcd	1260,1 cd	4,37 bc
Pasiano	6721 ab	52,7 bc	126,97 a	1121,5 d	6,14 a
Le Monde	7634 a	71,6 a	109,81 b	2335,4 a	3,44 cd
Palse	5922 bc	68,8 a	86,22 de	2194 a	2,75 d
Vistorta	2316,5 e	32,6 d	71,04 e	500,6 e	5,07 b

cv: Chardonnay

location	yield	clusters per vine	weight cluster	pruned wood	Ravaz index
Forcate	8642,6 a	68,3 a	126,52 a	1970,6 a	4,43 bc
S. Quirino	2743,7 d	31,8 f	87,16 c	503,5 f	5,85 ab
Dandolo	1938,4 d	33,4 ef	57,44 d	648,9 ef	2,95 cd
Sequals	5060 c	41,7 cde	116,22 ab	1188,7 c	4,69 ab
Barbeano	2798,7 d	36,8 def	78,80 c	1042,8 cd	2,76 d
S. Martino	4879,4 c	43,8 cd	111,45 ab	1134 c	4,35 bc
S.Giovanni	4503,3 c	43,7 cd	103,79 b	781,1 de	5,85 ab
Pasiano	7381,6 b	60 b	123,33 a	1604,8 b	4,95 ab
Le Monde	5345,1 c	49,2 c	108,41 ab	929,7 cd	6,18 a
Vistorta	4276,7 c	33,6 ef	121,68 ab	1031,5 cd	4,32 bc

cv: Tocai

location	yield	clusters per vine	weight cluster	pruned wood	Ravaz index
Forcate	5029,5 ab	24,4 bc	207,73 a	2129,3 b	2,44 c
S. Quirino	625,5 d	11,6 d	59,32 e	1750,5 bc	0,36 d
Sequals	4394,5 b	27,2 ab	163,25 bc	1627,3 c	3,11 bc
Barbeano	1933,5 c	29,3 ab	64,50 e	2905,1 a	0,70 d
S. Martino	4869 ab	33,9 a	144,56 cd	702,5 d	6,95 a
S.Giovanni	6086 a	33,6 a	182,60 ab	1811,9 bc	3,68 b
Vistorta	2382 c	18,3 c	131,86 d	1036,6 d	2,64 bc

cv: Pinot grigio

location	yield	clusters per vine	weight cluster	pruned wood	Ravaz index
Forcate	4411,5 bc	51,6 bcd	84,52 c	1287,6 b	3,70 cd
S. Quirino	4992,2 b	62,6 ab	78,39 cd	1708,3 a	2,92 d
Dandolo	3878,5 bc	38,4 d	102,09 ab	781,1 c	5,34 bcd
Sequals	3371 bc	35,6 d	89,62 bc	810,2 c	5,72 bc
Barbeano	2918 c	43,8 cd	67,42 d	832,5 c	3,83 cd
S. Martino	3844,7 bc	47,2 bcd	81,70 cd	1002,8 bc	3,96 cd
S.Giovanni	4937,8 b	55 bc	88,37 bc	1162,8 b	4,87 bcd
Pasiano	8363,1 a	75,2 a	113,19 a	804,4 c	10,42 a
Le Monde	4675,9 b	48,4 bcd	97,35 abcd	747,9 c	6,81 b
Palse	6927,8 a	71,5 a	97,85 abc	1774,2 a	4,06 cd

cv: Sauvignon

location	yield	clusters per vine	weight cluster	pruned wood	Ravaz index
Forcate	8645 b	71,7 ab	122,47 a	1334,7 bc	6,88 b
S. Quirino	3313,3 de	40,8 def	79,21 bc	912,6 de	3,58 cd
Dandolo	2107,8 fg	39,7 def	51,70 d	930,4 de	2,47 de
Sequals	1626,4 g	26,9 f	58,80 cd	1161,3 cd	1,42 e
Barbeano	2935 efg	43,8 de	70,03 bcd	1053,2 cd	3,15 cde
S. Martino	3389,8 de	42,5 de	77,19 bc	1743,9 a	2,15 de
S.Giovanni	4760 d	54,2 cd	87,99 b	1146,6 cd	4,42 c
Pasiano	10897 a	83,6 a	138,57 a	1150,6 cd	9,79 a
Le Monde	2278,8 fg	35,7 ef	62,39 ef	472,3 f	4,83 c
Palse	6707 c	63,7 bc	105,06 bc	1619,6 ab	4,36 c
Vistorta	4539,5 de	39,2 ef	115,30 b	623,8 ef	7,82 b

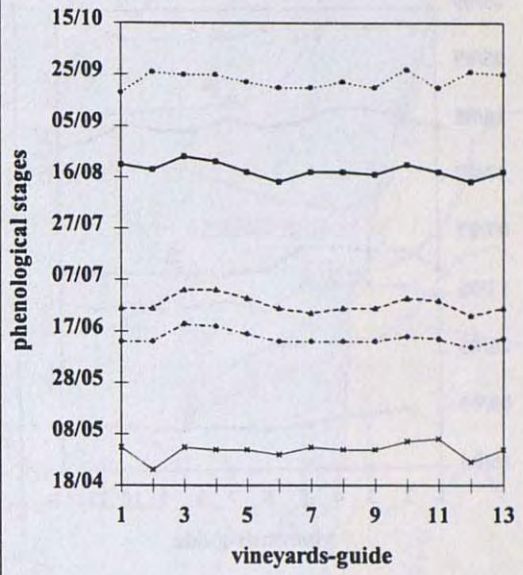
vineyards-guide

- 1 Forcate
- 2 S. Quirino
- 3 Dandolo
- 4 Sequals
- 5 Barbeano
- 6 S. Martino al Tagliamento
- 7 Versutta
- 8 S. Vito al Tagliamento
- 9 S. Giovanni di Casarsa
- 10 Pasiano di Pordenone
- 11 Le Monde
- 12 Palse
- 13 Vistorta

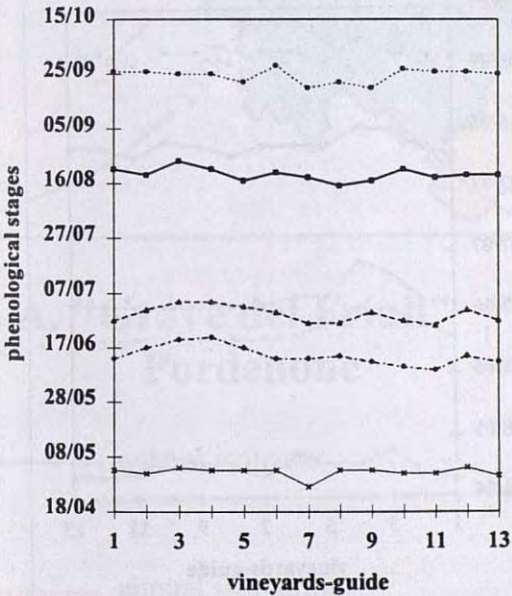
phenological stages

- budbreak
- - - bloom
- · - · - fruit set
- turned colour
- · - · - harvest

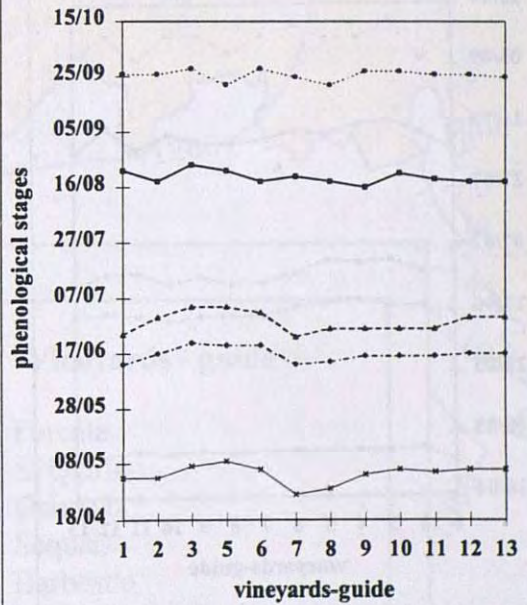
Merlot



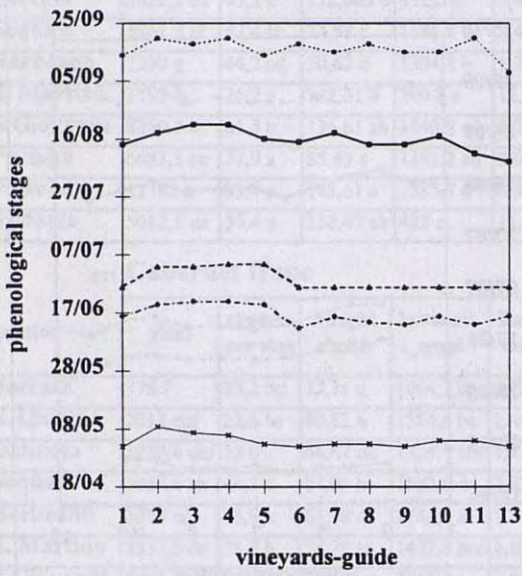
Cabernet Franc



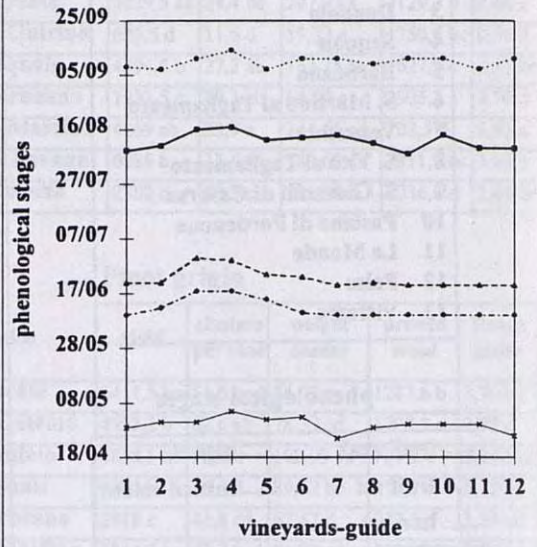
Cabernet Sauvignon



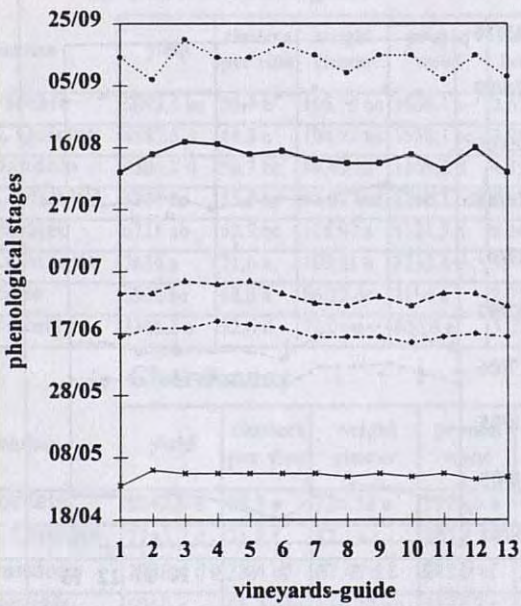
Tocai friulano



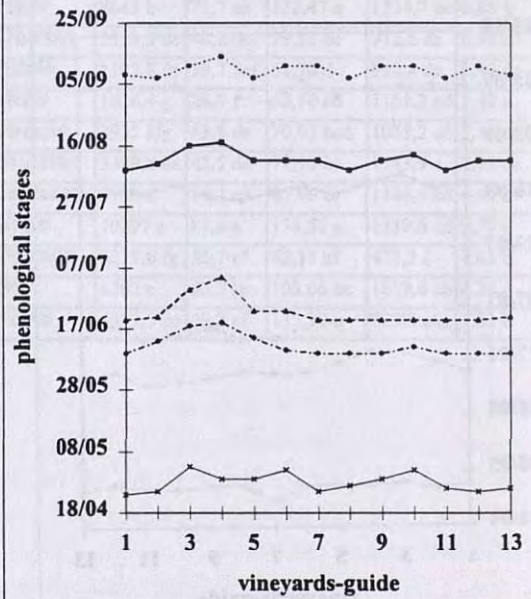
Pinot grigio

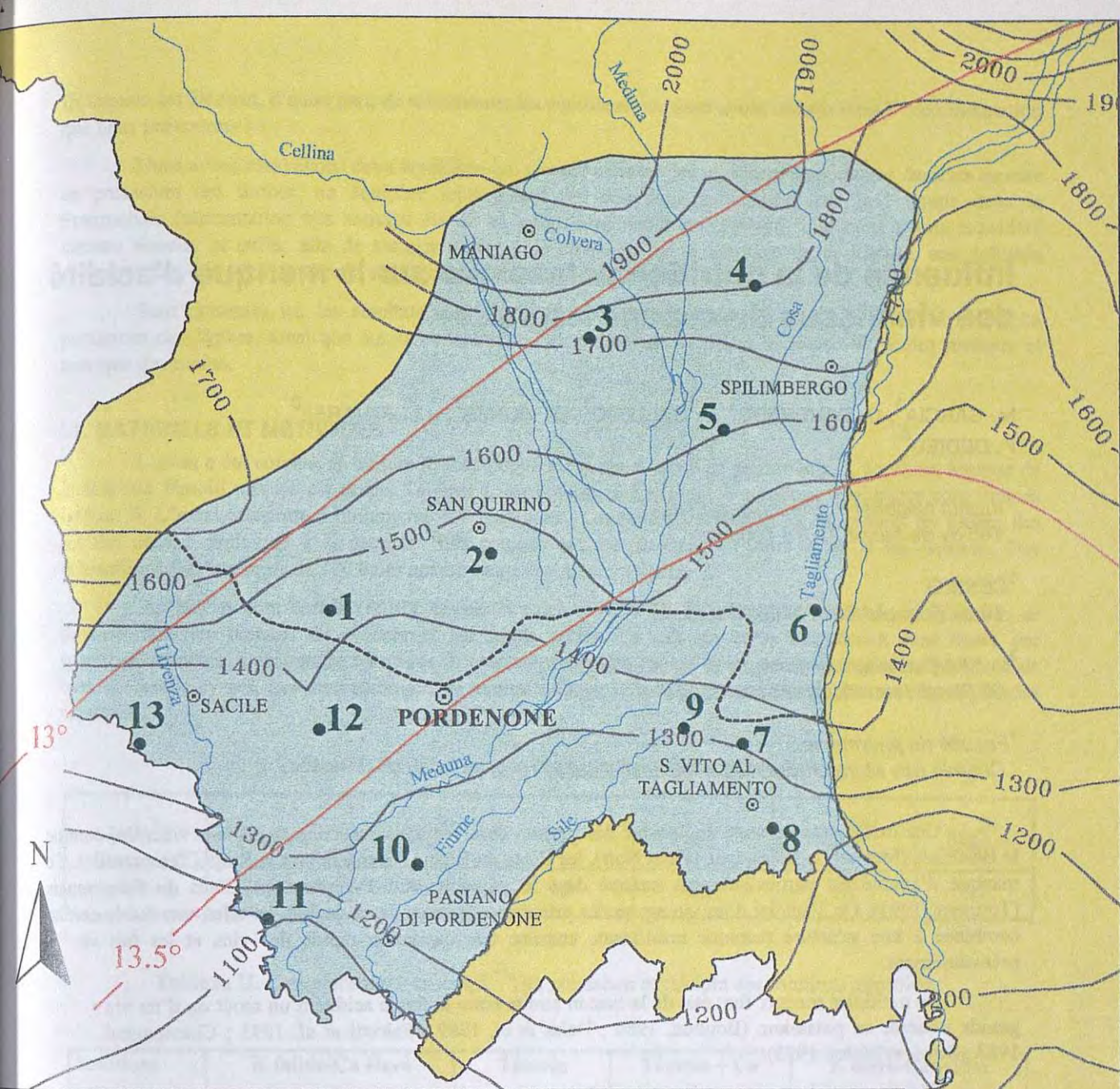


Sauvignon Blanc



Chardonnay





A.V.A. "Grave del Friuli" Pordenone

— annual isohyets

— annual isotherms

spring-line dividing area in:
"Alta pianura" (N)
"Bassa pianura" (S)

● vineyards - guide

Vineyards - guide

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