ZONING METHODS IN RELATION TO THE PLANT

An introduction

METHODES DE ZONAGE RELATIVES A LA PLANTE

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Professor Alain CARBONNEAU

Chaire de Viticulture et d'œnologie AGRO Montpellier

2 place P.Viala F-34060 Montpellier cedex

carbonne@ensam.inra.fr

The characterization of the plant is the obliged pathway between the environment and the product. The responses of the plant amplify or reduce the variations of the environment, while determining directly the type and the quality of the products. These results are inscribed inside the Viticultural Terroir Unit (VTU). VTU is the complex interaction between the Basic Terroir Unit or BTU (interaction mesoclimate x soil/subsoil), the genotype (variety x rootstock), the management system, the oenological technologies. Thus, at the most complex level, a global biological triptych is found again : environment (source) x plant (structure) = produced and exchanged substances.

It is important to note that the management system, resulting from the technical choices of the grower, generally acts on the environmental factors themselves, such as radiation, temperature, water and mineral element flux. Therefore, on one hand the study at the level of the plant is necessary to establish an objective link between the environment and the product, and on the other the observations in the plant concern the same variables as for the environment ; the zoning methods related to the plant must be associated to those concerning the environment, for a precise production.

It is possible to classify those studies as follows :

1/ Environment – plant links :

- ***Extra-temporal study at « macro/meso » level*** : the mean dominating regional macro/meso-climat over its variation along time, which is described by IS (drought index),IH (heliothermic index),IF (night coolness index) indices according to J.TONIETTO and A.CARBONNEAU, governs the main responses of the grapevine development and physiology ; such an influence has been demonstrated when modeling berry sugar content potential (viticultural agroclimatic zoning of European Union) ; figure 1 presents the map of Europe resulting of that study, in which one can notice the huge variability of mediterranean areas.

- ***Extra-temporal study at « meso/micro»level*** : BTU, regularly from year to year,determines the base of the terroir effect, in direct interaction with the management system ; such permanent effects have been shown for instance :

  - when modelling biochemical composition of Cabernet-Sauvignon berries and wines (INRA Bordeaux) which is illustrated by figure 2 where the importance of water balance, thermic conditions during maturation, exposed leaf area, minimum leaf water potential, is pointed out ;
  - or analysing the expression of the type of Syrah wines from sensorial analysis over 4 years (AGRO Montpellier/INRA) which is detailed in figures 3.a,b,c ; that Principal Component Analysis mainly shows close links between general quality and moderate water limitation or high exposed leaf area/yield, between aromatic characteristics (fruit, flower, spicy notes) and high exposed leaf area/yield or cool night temperature during maturation, between astringency of young wine and high heliothermic plus drought conditions.

    That indicates the terroir acts permanently on wine type, via environmental effects (water balance, thermic conditions), but also via interactive effects with technical choices (exposed leaf area/yield, water balance also ; we can add berry microclimate...). Therefore VTU is the real concept we must consider, and not only BTU.

- ***Temporal study at « macro/meso » level*** : the regular study of the grapevine responses at various time scales, allows to note the stability or the instability of the previous phenomenon, which justifies to relate a zoning work in function of time ; figure 4 shows the differences of BTU ranking in function of the vintages on a general quality axis from INRA Angers work : some are stable at a good or a poor level ; others are unstable.

  Over all, the main influence of the vintage at a regional level is noticed by many professions (climatic modelling of vintage, INRA Bordeaux) ; figure 5 presents the hierarchic classification of major factors of berry sugar content from INRA Bordeaux experiences, in which the vintage takes the first place.

  Also, major climatic influences, in particular on harvest earliness, have been registrated in relation to the 11 year solar activity cycle, or to the global climatic change which is shown on figure 6.

- ***Temporal study at « meso/micro » level*** : at BTU or VTU scale, it is possible for instance to model phenological stages, and to observe many relations between the meso-environment, the grapevine and the wine (INRA Angers terroir network, AGRO Montpellier/INRA Syrah network) ; that scale, useful for zoning, also allows to make link with the « micro » level which is pertinent to study plant physiology.

  Concerning the global study of terroir, the effect on wines must be performed over a high number of vintages, analysing the permanent effects and the specific ones. Figure 7 illustrates that point from INRA Bordeaux experiences on Merlot and Cabernet-Sauvignon including 2 terroirs (moderately dry gravelly soil and sand with an high water capacity) and 2 training systems (traditional Espalier and « Lyre ouverte » : on Cabernet-Sauvignon according to general quality in relation to red Bordeaux wine standard, it

appears that the training system has an effect as important as the terroir, the «Lyre in graves » being always the best, the « Espalier in sand » being always the worst, and the « Lyre in sand » or the « Espalier in graves » being intermediate changing from each other from year to year.

Finally, one must point out the great practical interest of remote sensing (satellite, plane) in orde to look at some elements of the BTU (groundlandscape) or of the VTU (responses to drought or bio-agressor attacks), and to integrate them at the regional scale.

2/ Plant physiology :

- ***Characterization of the micro-environment*** : it is necessary for measuring the reality perceived by the plant, reminding the importance of plant architecture at that level; thus, relations between micro-climate and architecture or canopy management have been quantified (INRA Bordeaux, AGRO Montpellier/INRA) ; also, references of predawn leaf water potential in relation to the concept of moderate water stress have been established (AGRO Montpellier). Figure 8 shows a large sampling of vine architectures studied by INRA Bordeaux, with their global response on wine quality; notice the best position of the U shape which lead to the Lyre, due to high value of exposed leaf area, optimum berry exposure, important wood reserves.

- ***Characterization of the physiology*** : the synthesis of recent researchs on grapevine ecophysiology points out the interest of multivariate studies based on a biological triptych « source-structure-produced and exchanged substance » ; for the grapevine, the berry maturation is mostly bound to an equilibrium between the Exposed Leaf Area ELA or net source of carbon, the vigour or speed of elaboration of the concerned structures, the Production of dry matter or « powerness » which can be reduced to crop and involves as a physiological sink the substances which are looked for.

  Figure 9 presents the general concept of positioning a vineyard (VTU) on a diagram « total dry matter production or general sinks » versus ELA or general sources, each curve of that diagram corresponding to a given vigour level in general to a water balance level; such a method allows either to position a particular terroir or to choose a suitable training system as indicated at the bottom of the figure on the basis of the potential ELA.

- ***Characterization of the product by biochemistry and sensorial analysis*** : the different available methods in that field can be directly related to the plant physiological variables ; one must notice, as for the study of the plant physiology , the interest to think about the equilibriums between variables.

In conclusion, we can point out the fact that the most original or typical element of the terroir is not the BTU alone, but the VTU which expresses the « language » of the vine.

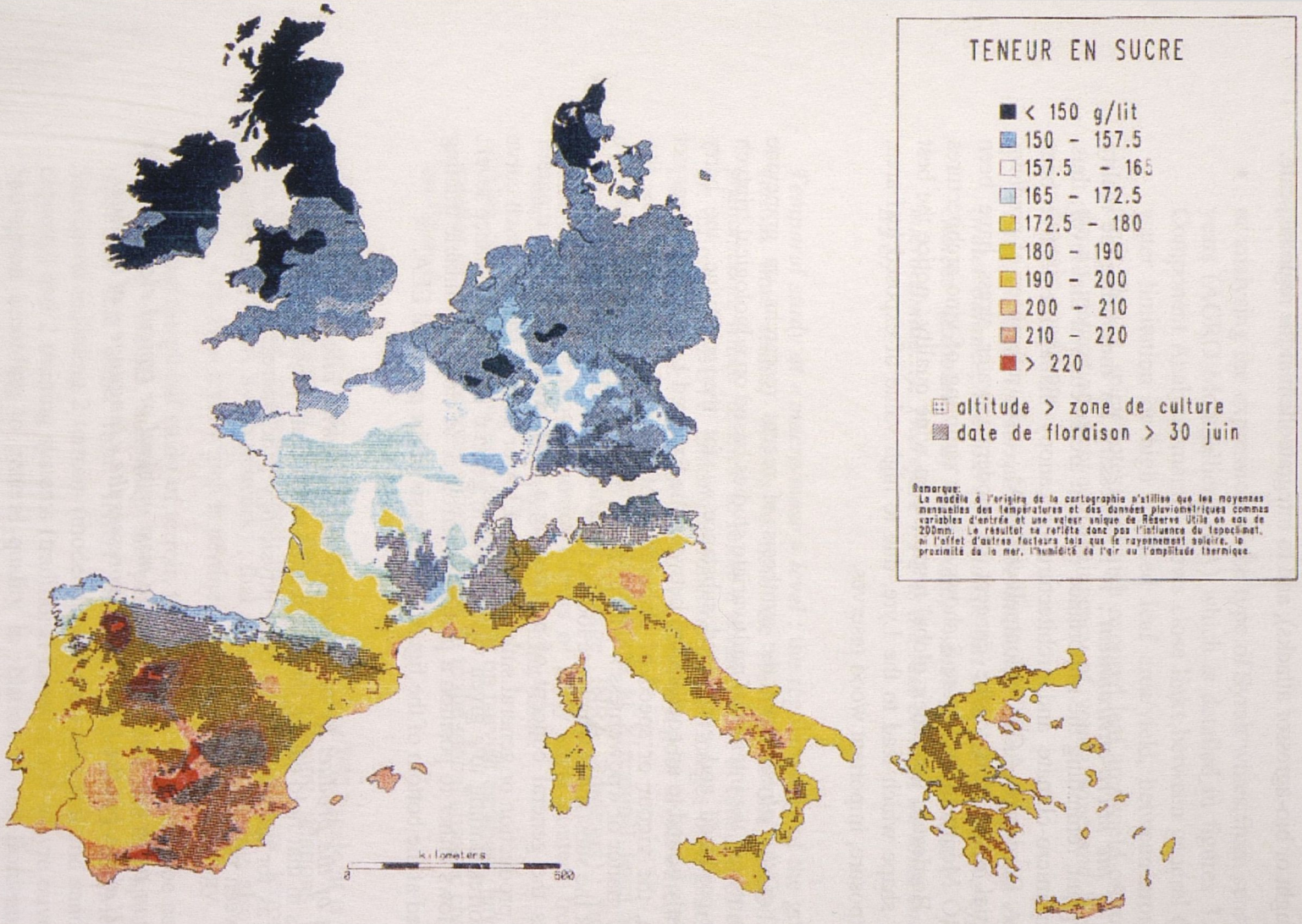
TENEUR EN SUCRE
< 150 g/lit
150 - 157.5
157.5 - 165
165 - 172.5
172.5 - 180
180 - 190
190 - 200
200 - 210
210 - 220
> 220
altitude > zone de culture
date de floraison > 30 juin
Remarque:
Le modèle à l'origine de la cartographie n'utilise que les moyennes mensuelles des températures et des données pluviométriques comme variables d'entrée et une valeur unique de Réserve Utile en eau de 200mm. Le résultat ne reflète donc pas l'influence du topoclimat, ni l'effet d'autres facteurs tels que le rayonnement solaire, la proximité de la mer, l'humidité de l'air ou l'amplitude thermique.
kilometers
0
500

Figure 1

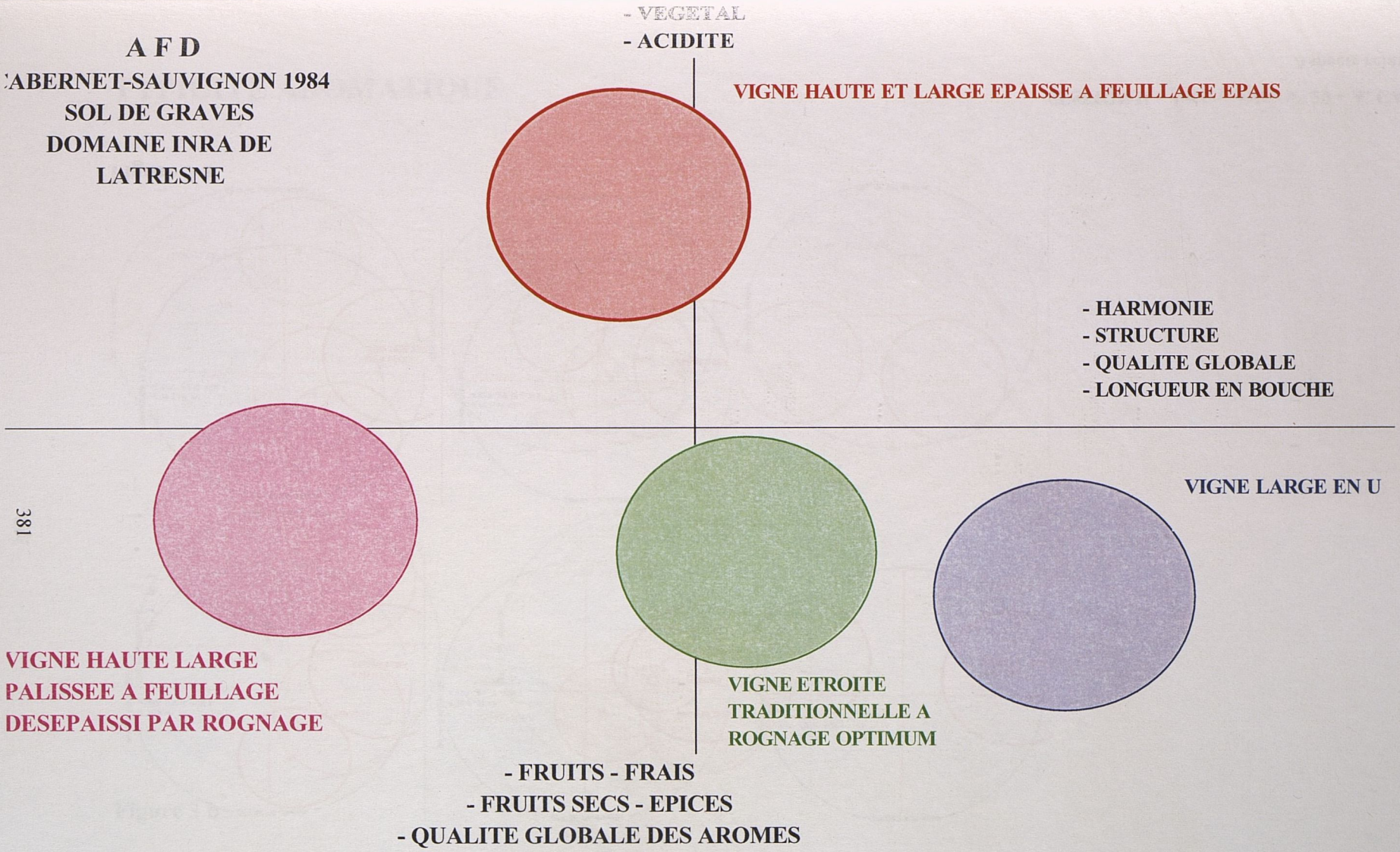
A F D
CABERNET-SAUVIGNON 1984
SOL DE GRAVES
DOMAINE INRA DE
LATRESNE
- VEGETAL
- ACIDITE
VIGNE HAUTE ET LARGE EPAISSE A FEUILLAGE EPAIS
- HARMONIE
- STRUCTURE
- QUALITE GLOBALE
- LONGUEUR EN BOUCHE
VIGNE LARGE EN U
VIGNE HAUTE LARGE
PALISSEE A FEUILLAGE
DESEPAISSI PAR ROGNAGE
VIGNE ETROITE
TRADITIONNELLE A
ROGNAGE OPTIMUM
- FRUITS - FRAIS
- FRUITS SECS - EPICES
- QUALITE GLOBALE DES AROMES

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Figure 2

QUALITE GLOBALE

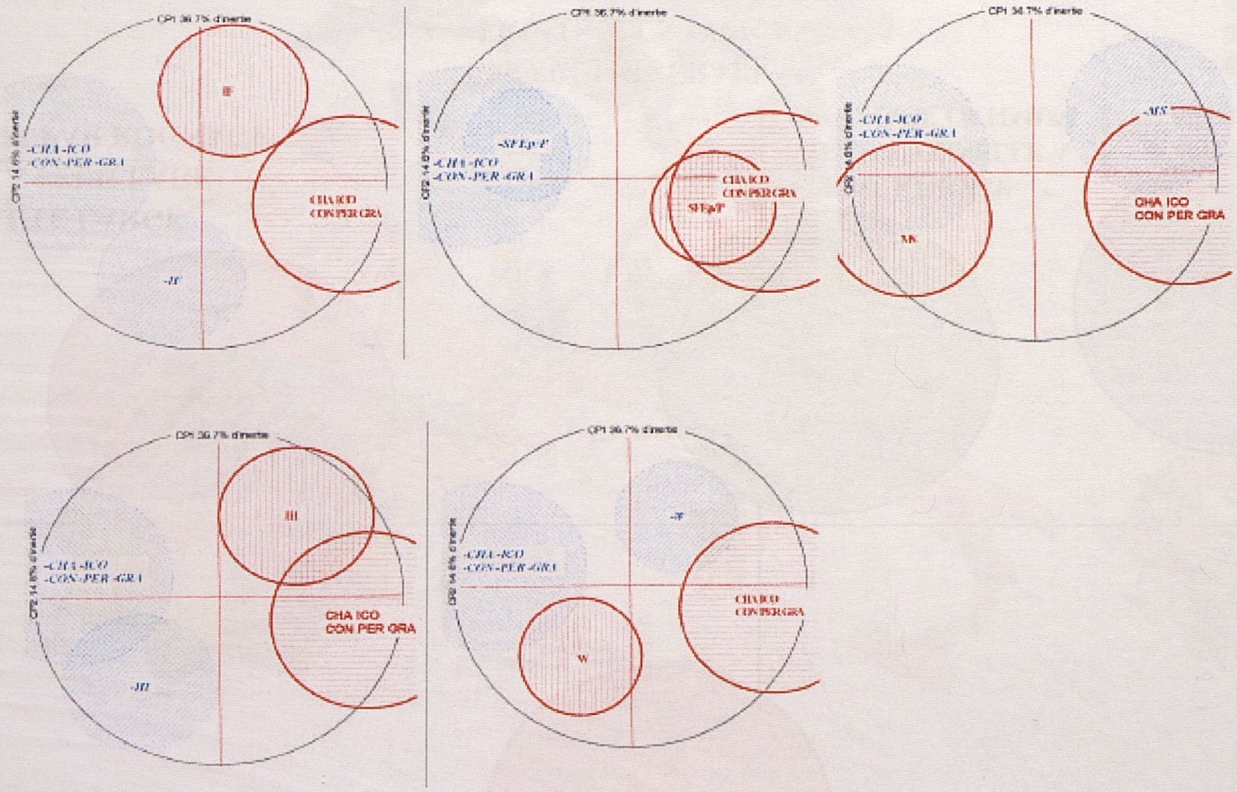

Figure 3 a

TYPICITE AROMATIQUE

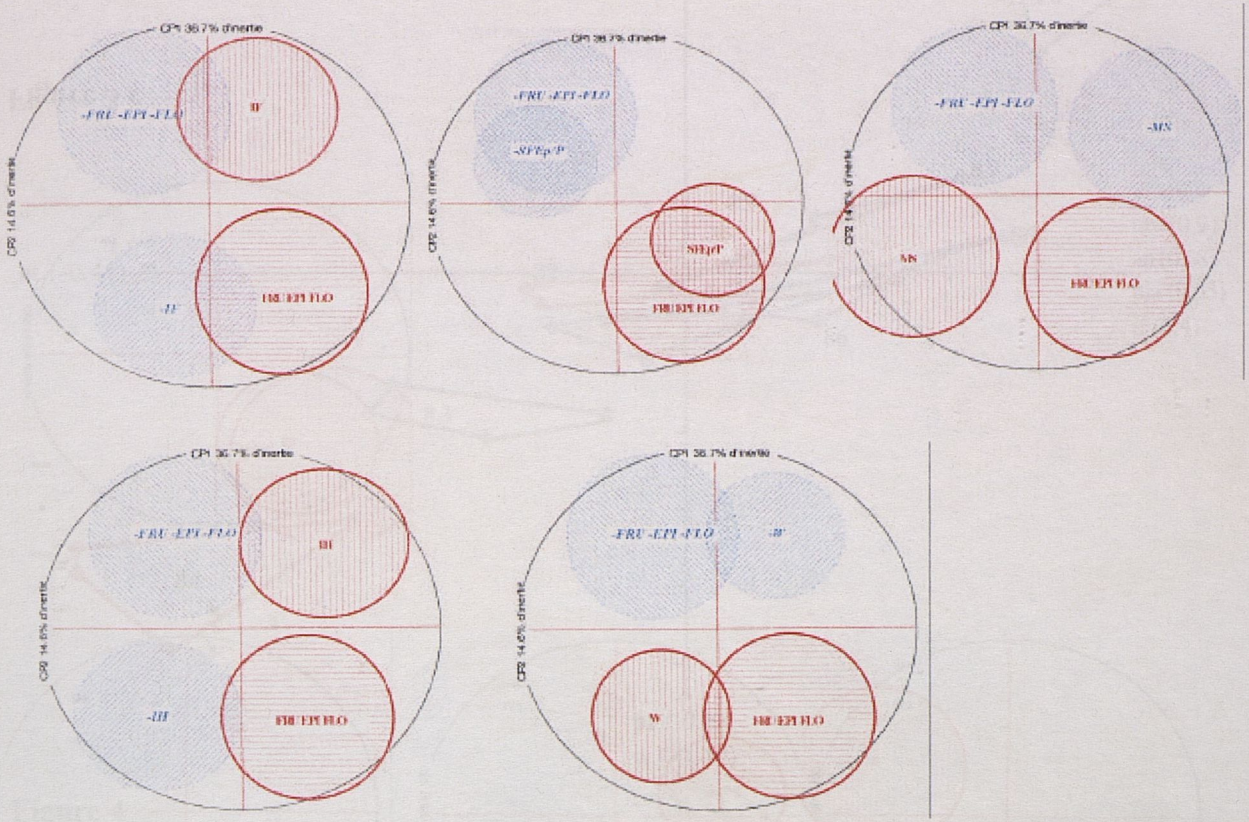

Figure 3 b

ASTRINGENCE

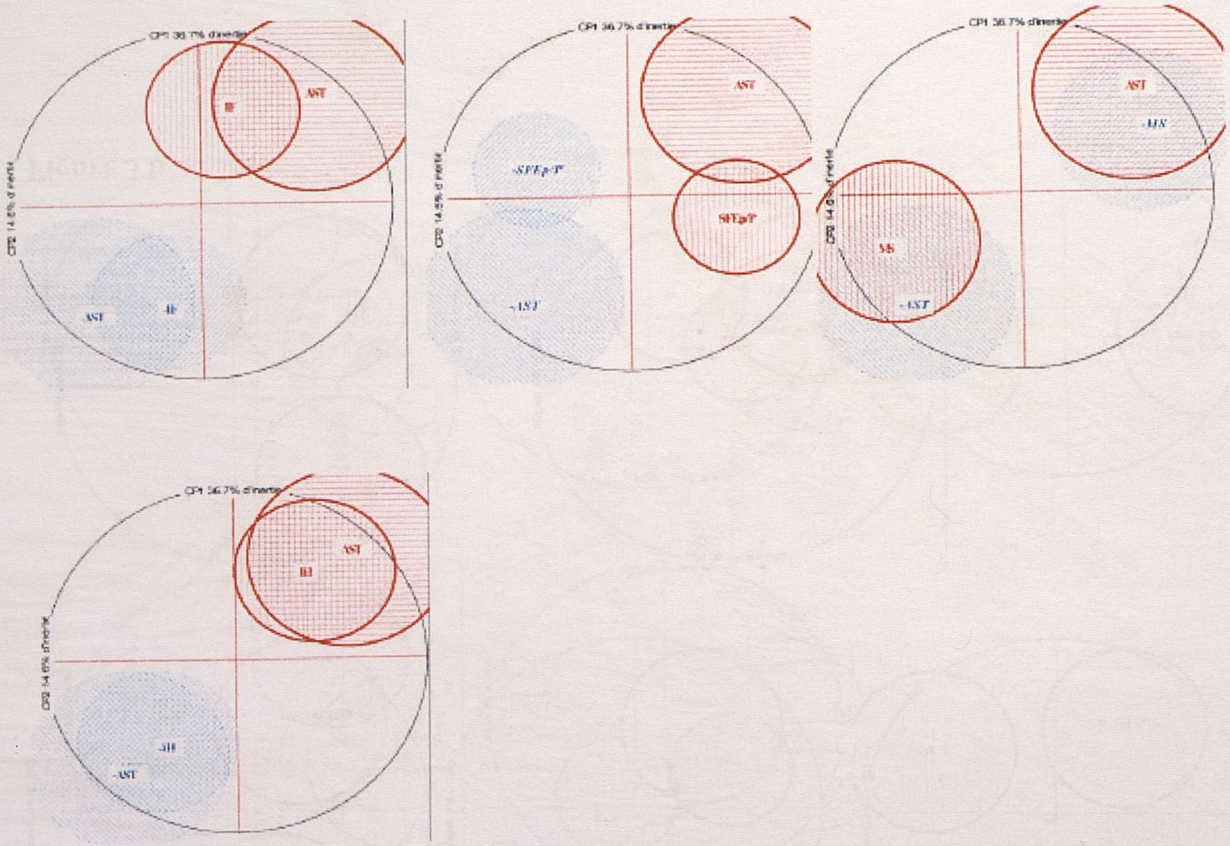

Figure 3 c

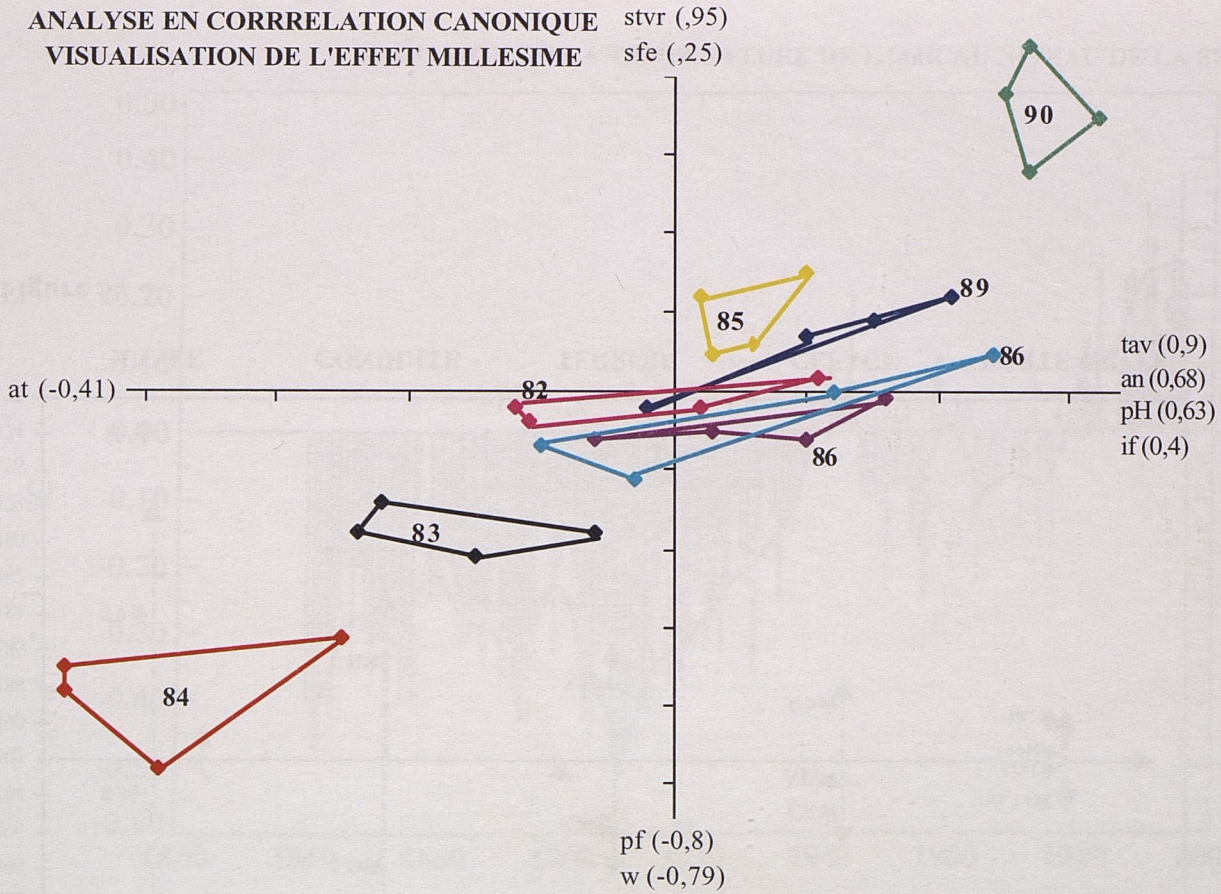
ANALYSE EN CORRRELATION CANONIQUE
VISUALISATION DE L'EFFET MILLESIME
stvr (,95)
sfe (,25)
90
89
85
86
82
86
83
84
at (-0,41)
tav (0,9)
an (0,68)
pH (0,63)
if (0,4)
pf (-0,8)
w (-0,79)

Figure 4

TENEUR EN SUCRES REDUCTEURS TOTAUX DU MOUT (g/l)

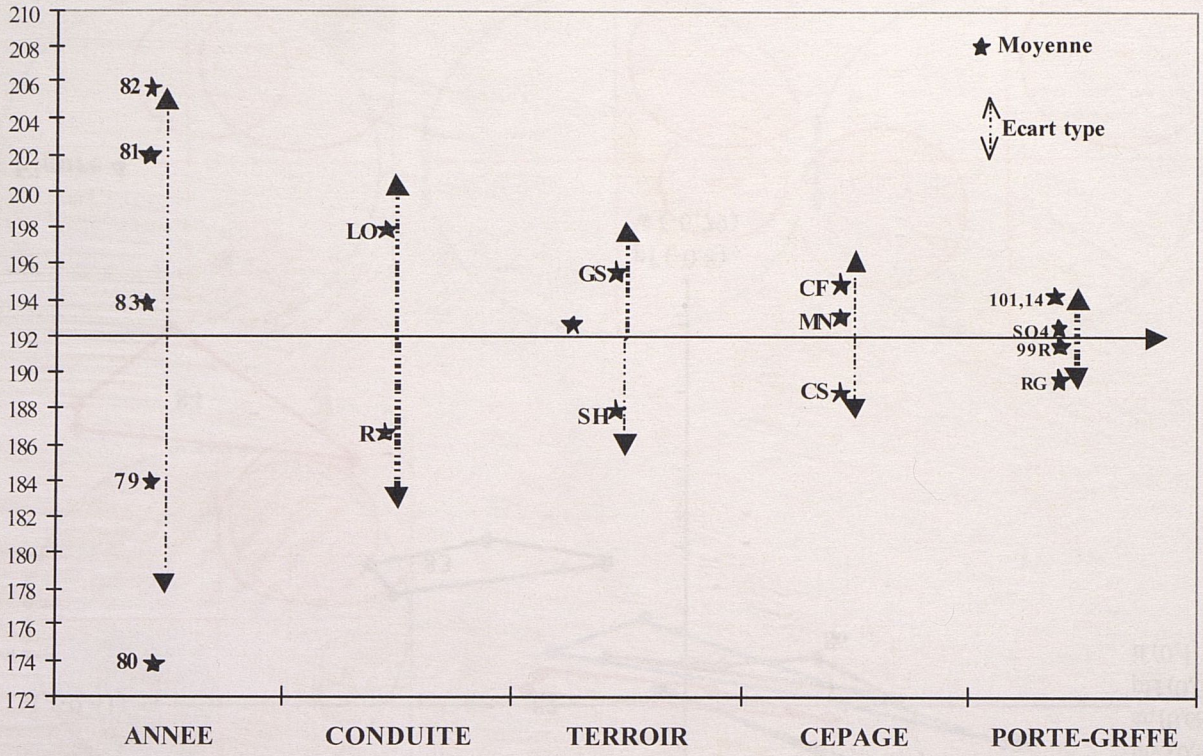

Figure 5

VARIATION DE LA TEMPERATURE DE L 'AIR AU NIVEAU DE LA SUPERFICIE DU GLOBE

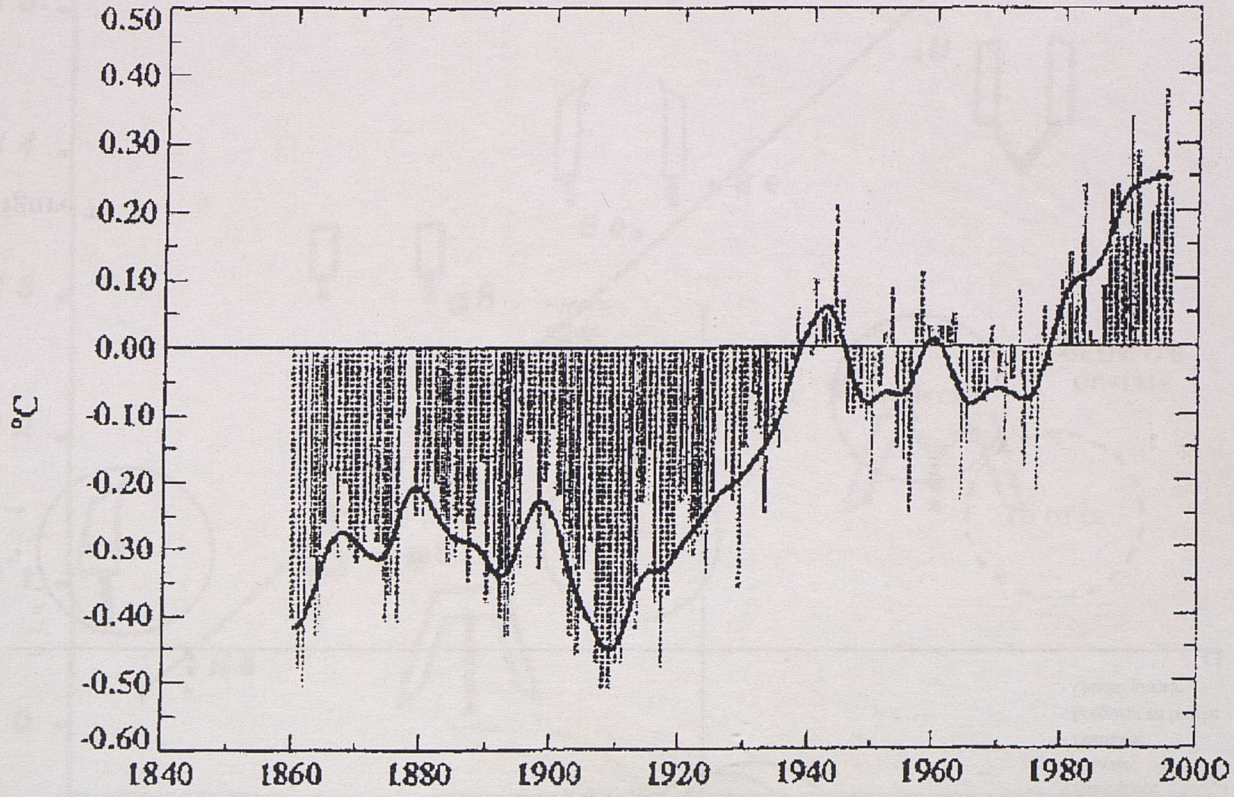

Figure 6

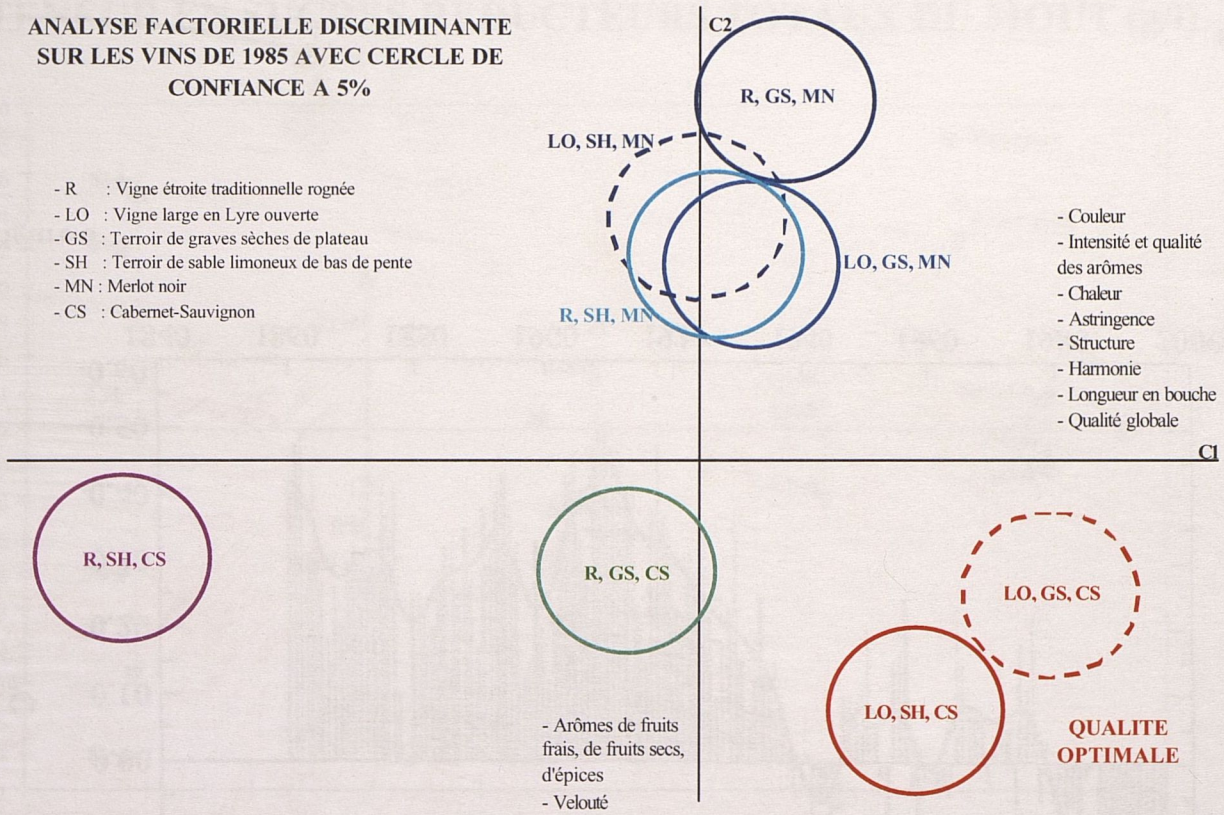
ANALYSE FACTORIELLE DISCRIMINANTE SUR LES VINS DE 1985 AVEC CERCLE DE CONFIANCE A 5%
- R : Vigne étroite traditionnelle rognée
- LO : Vigne large en Lyre ouverte
- GS : Terroir de graves sèches de plateau
- SH : Terroir de sable limoneux de bas de pente
- MN : Merlot noir
- CS : Cabernet-Sauvignon
C2
R, GS, MN
LO, SH, MN
LO, GS, MN
R, SH, MN
- Couleur
- Intensité et qualité des arômes
- Chaleur
- Astringence
- Structure
- Harmonie
- Longueur en bouche
- Qualité globale
C1
R, SH, CS
R, GS, CS
LO, GS, CS
LO, SH, CS
QUALITE OPTIMALE
- Arômes de fruits frais, de fruits secs, d'épices
- Velouté

Figure 7

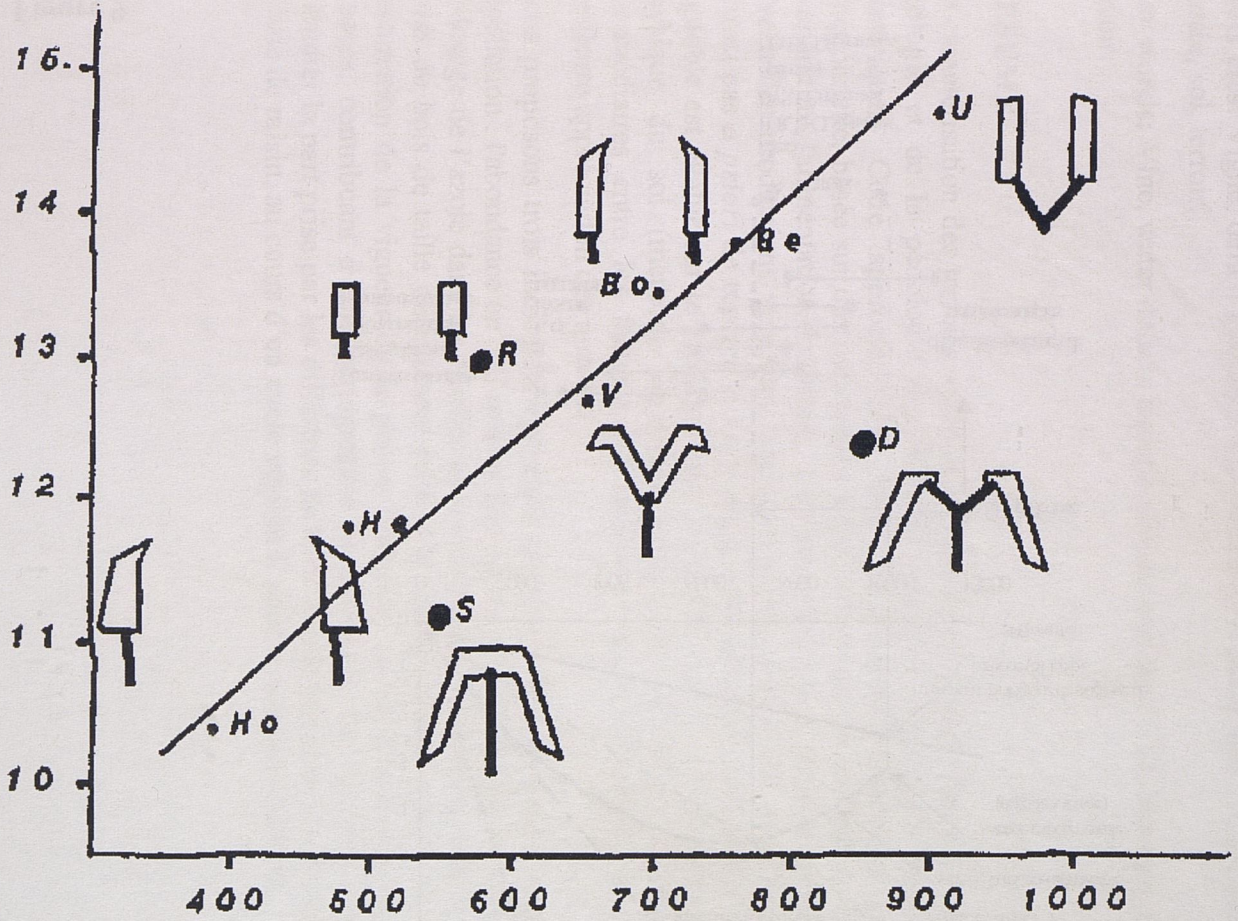

Figure 8

RELATION ENTRE PUISSANCE (P) et SURFACE FOLIAIRE EXPOSEE POTENTIELLE (SFEp)

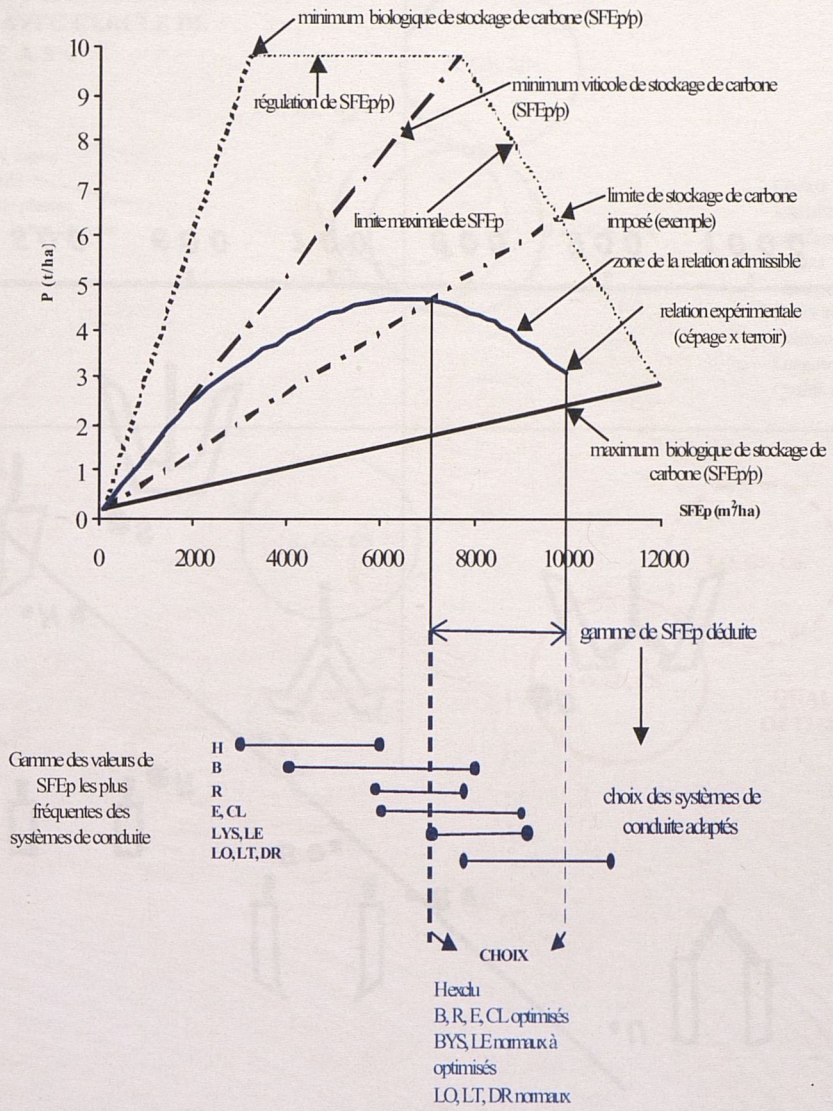

Figure 9