

The Grafting and Top-grafting of vines by the *T-bud* and *Chip-bud* Methods



Presentation

I- The grafting techniques

Introduction : Presentation of W.V. and the Grafting 's definitions

A- The characteristics and interests

- 1) The technical and practical levels
- 2) The economic point of view

B- The working and methods

- 1) The mechanics of the graft
- 2) The different techniques
- 3) The grafting's limits

C- Physiology and consequences

- 1) The vine's disorder (ex. Grenache, Syrah, Esca, frost)
- 2) The plant material selections
- 3) Success rates and statistics

II- The grafting operation

A- Preparation and completion

- 1) The grafting's costs
- 2) The preparatory works and the bud-sticks
- 3) The grafting operation

B- The seasonal works

- 1) The aftercare works
- 2) Accidents and diseases

C- The subsequent works

- 1) Pruning and maintenance of the grafts
- 2) Maintenance in the following years

Conclusion : The key physiological stages Table.

Worldwide Vineyards

Excellence in Grafting and Top-grafting solutions

- Offers consultancy and full services in Viticulture, since its creation **in 1985**
- Progressively specialized in the grafting and top-grafting of vines, after its founder **introduced** some **American techniques** which have been adapted to **suit the more temperate European climates**.
- Renowned European expert in the **T-Bud and Chip-Bud Techniques**
- Has completed **millions top-grafts** to date
- and keeps innovating with the **Grafting Kit**, which makes from now on these **techniques accessible to all**, whereas they required so far, skill and dexterity.

There is a conversion solution for any vineyard

From now on, anyone can carry out grafts in the field, directly onto rootstock or topgraft an aging vine.



Our grafting services



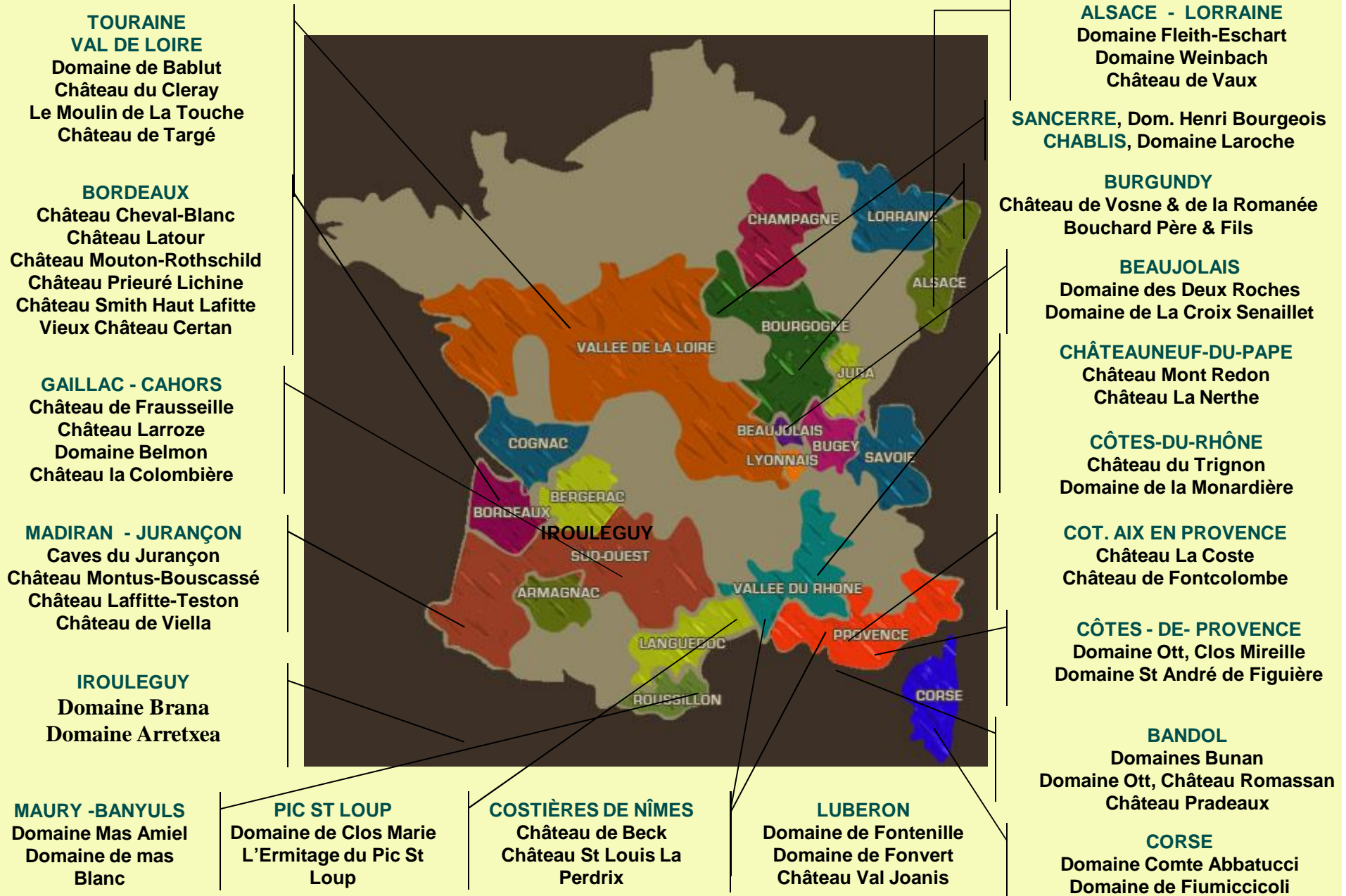
⇒ Intervention with our teams of professional grafters all over the world

⇒ Sale of Grafting kits and all the necessary equipment for grafting

⇒ Consulting missions, technical support and follow-up

⇒ Individual or group training courses, that combine theoretical and practical sessions to learn the T-bud and Chip-Bud grafts.

Some Customers' References in France



Some Customers' References in Europe

GREAT BRITAIN

Denbies Wine Estate
Plumpton College
Nyetimber Limited

SWITZERLAND

Agriloro S.A.
Domaine Louis Bovard
Domaine Chappaz
Domaine de la Rochette
Clos de Celigny

PORTUGAL

Fund. Eugénio de Almeida
Herdade do Esporão
Quinta do Carmo
José Maria Da Fonseca
Real Companhia Velha

SPAIN

Abadia Retuerta
Mas Martinet
Dominio Valdepusa
Bodega Mustiguillo
Clos Mogador

ITALY

Tenuta
Tignanello
Ca' del Bosco
Gaja
Tenuta
Ornellaia
Prunotto
Casa Vinicola

MALTA

Meridiana Wine Estate
Delicata Wine
Marsovin
Camilleri

GERMANY

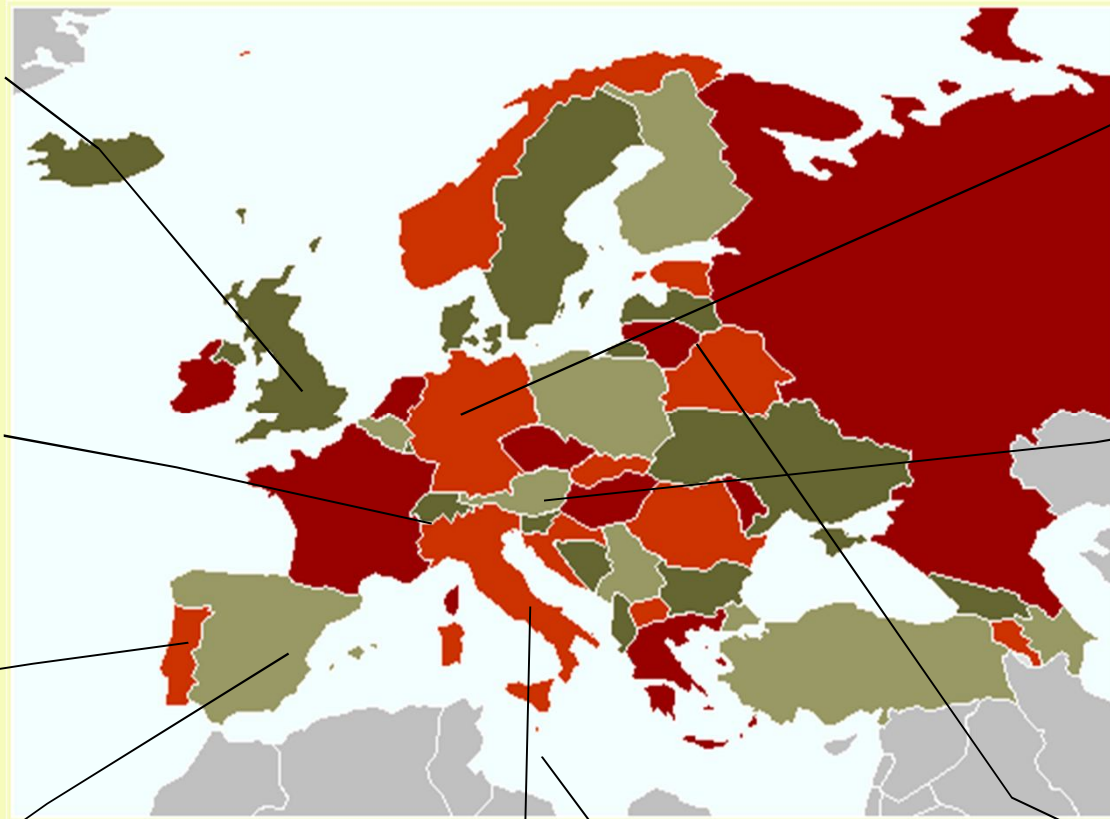
Schlossgut Diel
Weingut Kühling-Gillot
Weingut St Antony
Weingut Johanningner
Schlumberger SA

AUSTRIA

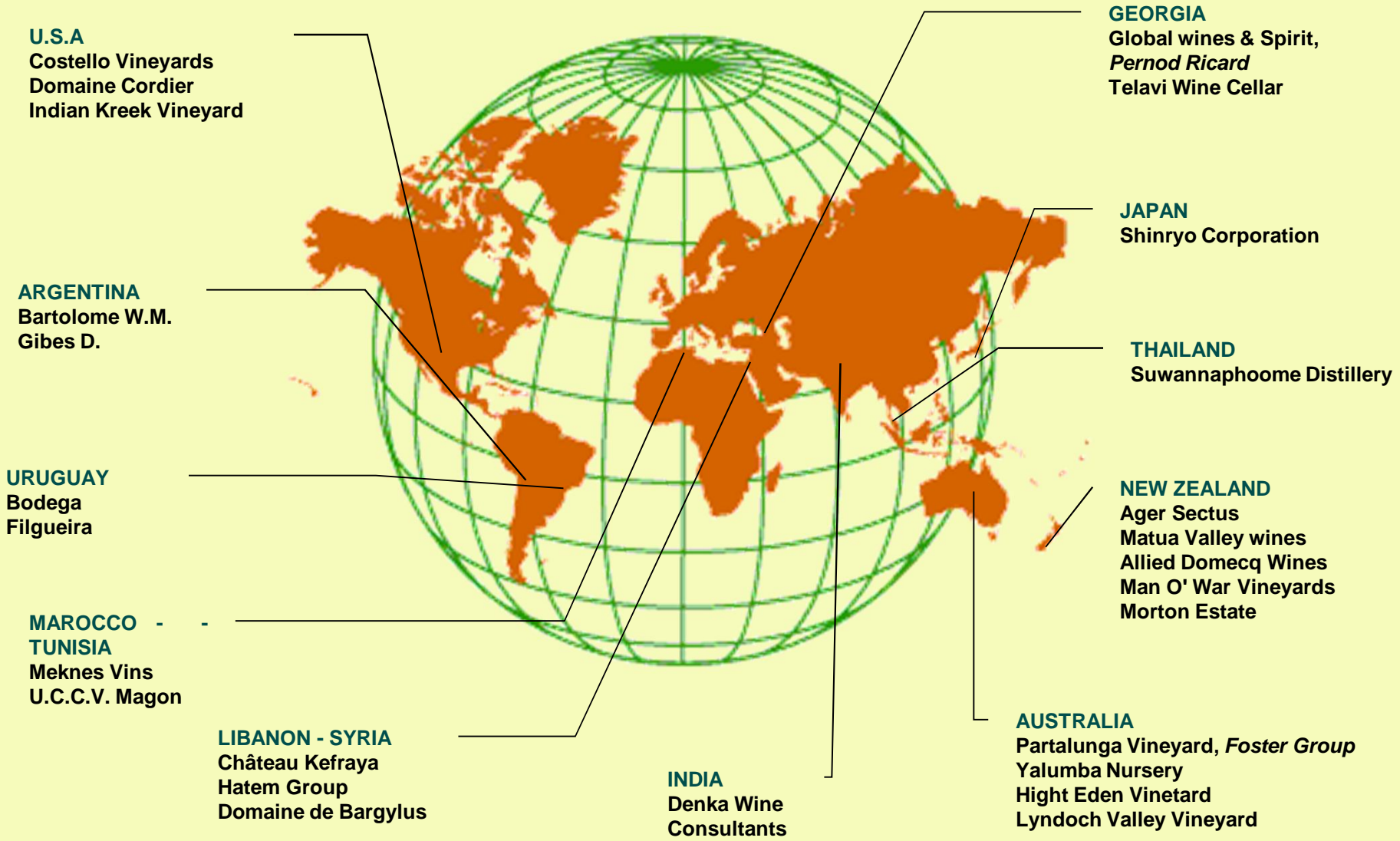
Weingut Feiler-Artinger
Weingut Pittnauer
Weingut Nittnaus
Weingut Stift
Klofterneuburg
Weingut Johanneshof

HUNGARY

European Wine Producer
Tokajhegyaljai A. G.
Weninger KFT



Some customers' references throughout the world



Grafting's definition

- **L. Noisette, « Traité complet des greffes », 1830 :** *« La greffe n'est rien d'autre qu'une plante qui, au lieu d'être faite dans la terre et d'absorber les fluides nutritifs des racines, est située sur un objet enraciné dont elle absorbe les fluides nutritifs en mettant en relation ses vaisseaux substantiels avec ceux du sujet ».*

Grafting :

« In a generic sense, Grafting is used to describe all the operations of grafting, top-grafting and re-grafting ».

Top-grafting :

« Operation which consists of grafting a vine which has already been grafted, in order to add certain characteristics of the new scion »

Re-grafting :

« This means the making of a new graft on the same subject, after the failure of a previous attempt ».

TECHNICAL ADVANTAGES OF TOP-GRAFTING

- **Modify the established vine variety** in one year, with a loss of a single crop, **only**.
- Maintain a healthy, well developed **root system** and **rapidly** obtain a **mature wine**.
- **Conserve** the existing trellis structure.
- Rapidly **modify the training and pruning system**.
- **Rejuvenate older vine trunks** (Decline).
- Rapidly **experiment with new cultivars or plant material selection**, before deciding on planting.
- **Standardize the assortment** of grape varieties, and even improve mixed plantations.
- Easily ensure the **preservation** and **propagation** of endangered plant material and maintain diversity within the vineyard.

TECHNICAL ADVANTAGES OF GRAFTING ONTO ROOTSTOCK

- **Consider plantation on the long-term**
- **Favor the rooting** of the vine.
- Get a **qualitative bonding** using qualitative **manual grafting** techniques and materials with adjust diameters.
- Successful **plantings** in **November**
- Position the graft's knitting point **in height**, away from the ground (frost areas / soil tilling equipments)
- **Limit the** phenomena of **premature decline** (???)
- **Lower needs for water** at plantings than with grafted vines.
- Opportunity to practice **dormant eye grafts** in hot areas (Southern and tropical regions).

PRACTICAL ADVANTAGES OF GRAFTING WITH A SINGLE BUD

- Opportunity to reason completely **autonomously** and directly his own production of **wood and vine plants**.
- Idea of preserving wealth and **plant diversity**.
- **Optimize contact** between the **cambium** of both the subject and the scion to ensure continuity of the vascular system:
 - less wounds and surgical necrosis
 - Better chances of success (success rate)
 - Extended life expectancy of the plant
- Semi-mechanized techniques **easy to practice**.
- Possibility to keep a terminal stem on the top of the trunk, which allows:
 - **a minor trauma** when beheading the stock
 - Possibility to **guarantee success** due to the conservation of a **terminal stem** which keeps the stock alive and enables re-grafting on the same trunk.

Cost of a grafting operation on 3000 vines by an outside enterprise with a 90% Success Rate guarantee and technical follow up

Length of intervention: 1,5 day with a team of 6 grafters

Success rate: **≥90%** Number of graft to complete and invoice: **3000**

Corresponding bracket: 2000 to 4000 vines

Formula to be applied: $(4400 + ((3000 - 2000) * 2,00)) / 3000$ **Unit Price: 2,13 €**

1. Total amount of the provision of services : **6 390,00 €**

2. Accommodation (Half Board and breakfast): (If the client doesn't directly organize and pay for it)

1,5 day x 6 grafters x 63,60 € **572,40 €**

3. Total amount to be paid – (VAT exempt) **6962,40 €**

Cost of a grafting operation on 3000 vines by an outside enterprise without a guarantee or technical follow up

Length of intervention : 1,5 day with a team of 6 grafters

Number of graft to complete and invoice : **3000**

Unit Price : 1,30 €

1. Total amount of the provision of services : 3 900,00 €

2. Accommodation (Half Board and breakfast): (If the client doesn't directly organize and pay for it)

1,5 day x 6 grafters x 63,60 € **572,40 €**

3. Total amount to be paid – (VAT exempt) 4472,40 €

ECONOMIC ADVANTAGES OF TOP-GRAFTING

Because the root system of a vine is more robust than the aerial parts, and longer lasting, top grafting can be confronted to replanting as far as vineyard restructuring is concerned.

Subsidies of the conversion programmes for vineyards in France and E.U. also cover restructuring by top-grafting.

Comparative costs of renewal by top-grafting (with a service provider) and by replanting, for one hectare of 3000 vines with a profitability of 6.288 €

Type of intervention	Direct costs	Loss of crops	Overall cost
Grafting with a service provider	11 880 €	6 288 €	18 168 €
Uprooting and replanting	20 123 €	18 863 €	38 986 €
Différence	- 8 243 €	- 12 575 €	- 20 818 €

Consequencies and comments

D. Scheidecker, « La greffe, ses conditions anatomiques, ses conséquences physiologiques et ses résultats génétiques éventuels », 1961 :

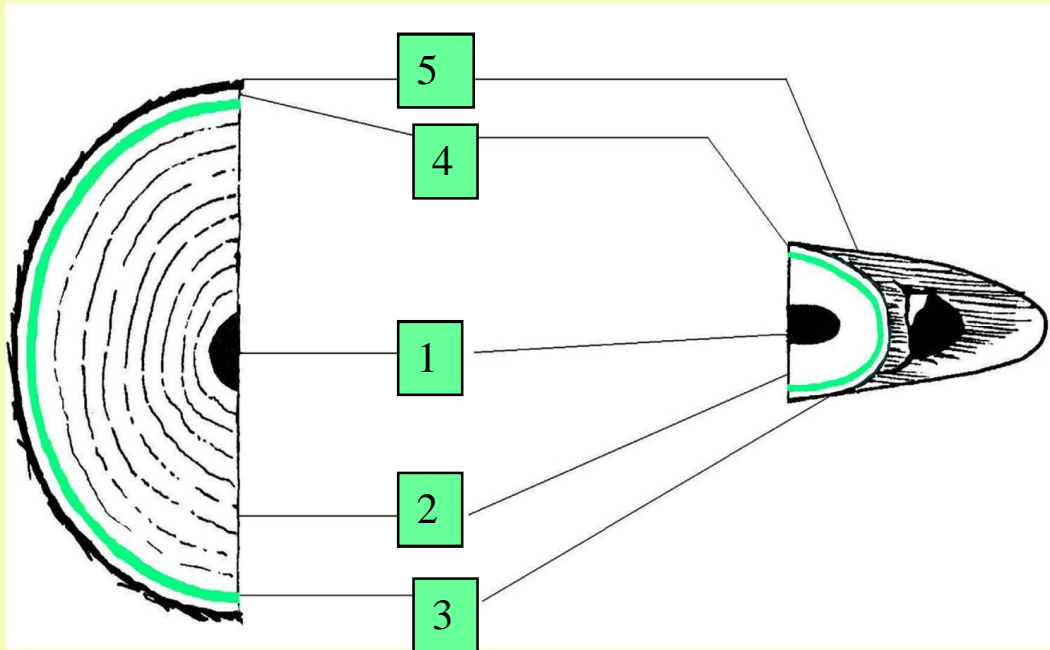
*« L'intervention chirurgicale du greffage a pour conséquence la formation du **bouurrelet cicatriciel de soudure**. La **structure anatomique** de ce bouurrelet, structure qui déterminera en grande partie son **rôle physiologique**, varie considérablement d'une greffe à l'autre. Elle dépend de la nature des plantes en jeu, mais aussi de leur âge et de leur stade de développement au moment de l'opération, ainsi que de la **technique de greffage choisie** ».*

- **B. Drouhault**, "Revue de Viticulture", 1895 : « ...c'est de la perfection des soudures que dépendent surtout la vigueur et la longévité des vignes greffées [...] On cherche souvent la cause du dépérissement de beaucoup de ceps dans des phénomènes plus ou moins caractérisés, alors qu'elle réside simplement dans une mauvaise soudure ».

Section of the Wood : Trunk and Scion

The grafting principle is to bring the scion's and rootstock's **cambiums** into contact, to join together the phloem (conduction) and xylem tissues (support).

The bonding depends on the faculty of the wounded tissues to proliferate, giving birth to undifferentiated cells, capable of producing conductive elements within the scar unit.



1- Pith

2- Wood (xylem) : conducts the crude sap

3- Cambium (formation of callus)

4- Bast (phloem) : conducts organic nutriment

5- Bark



Healing and vascularisation

- - The callus (Boyceau de la Baraudière, 1638), a **scar tissue** (a white-yellow bumpy mass which cells have the appearance of tiny cauliflower) arises from proliferation of cambium and phloem's internal cells, as a reaction to **cuts** or wounds.
- - The scion has a stimulating effect on the callus, polarized towards the lower part of the eye.
 - The callus formation is easier on the outer ends of the oblique cuts of the scion.





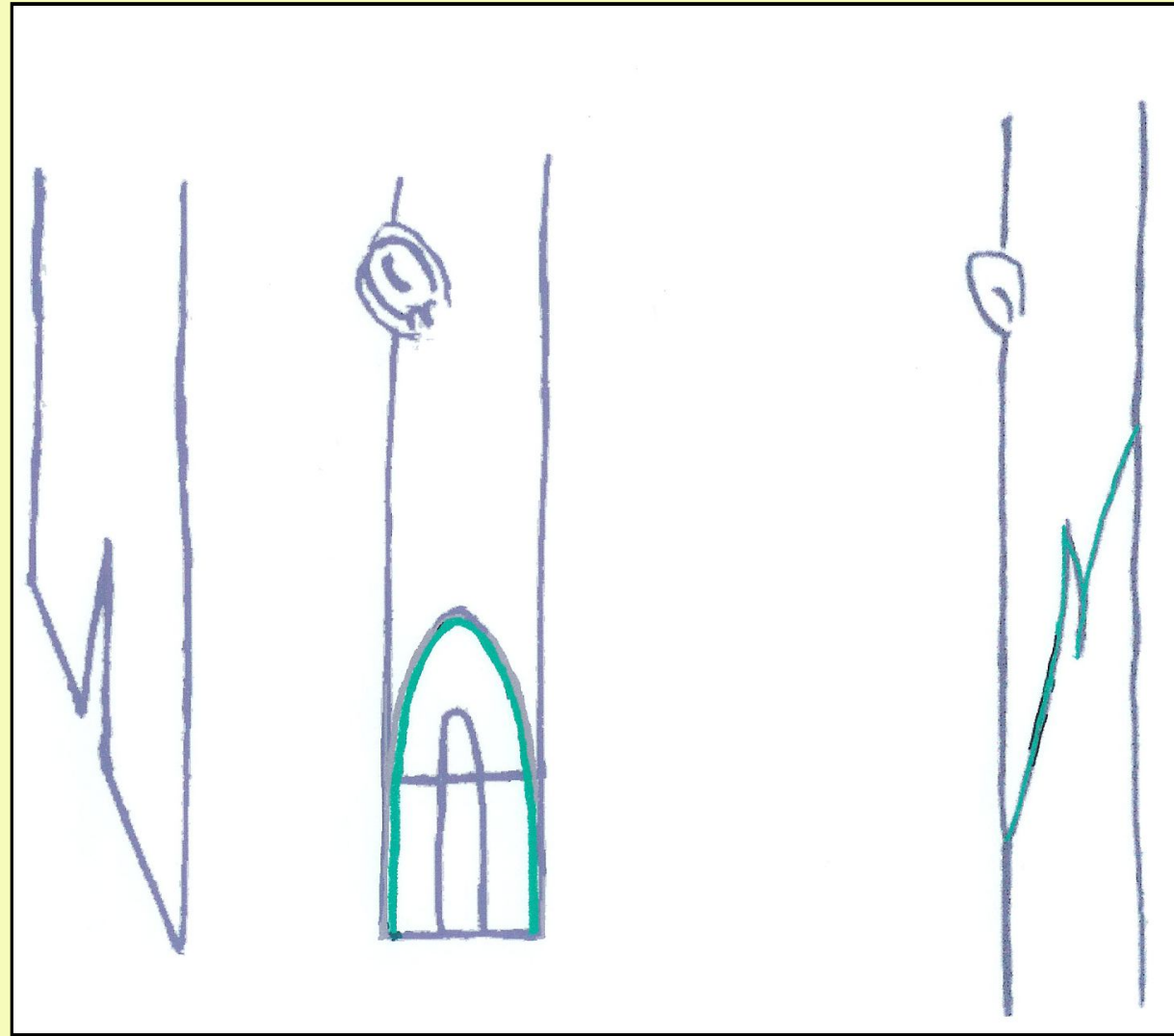
The Approach Graft

Example
of a natural
joining process
with a
Locust tree

The *Omega* Graft : Grafting scion / subject



The *Whip* Graft



The *Whip* Graft

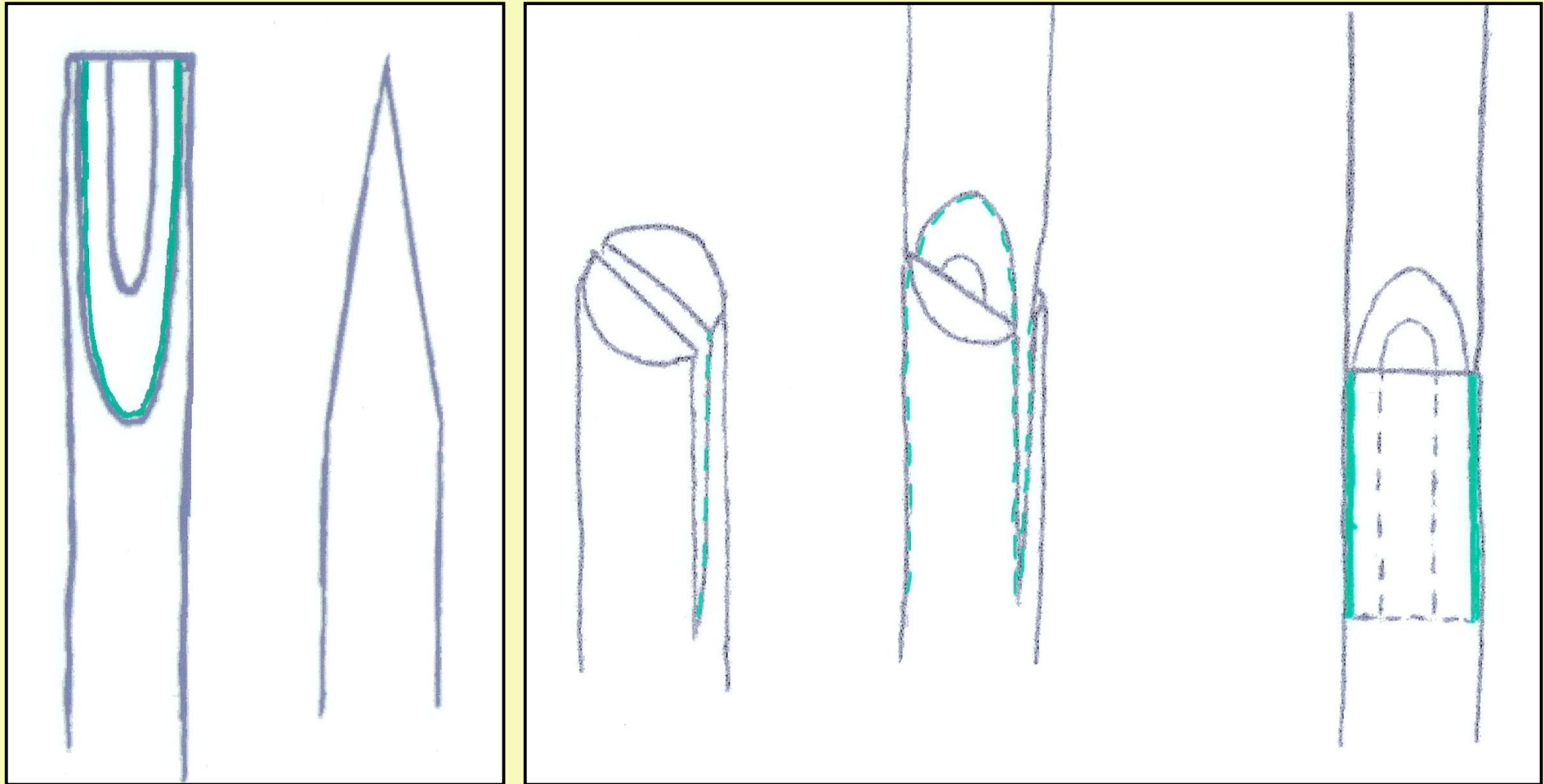




The Jupiter Graft,

Mechanical
version of the
whip graft

The full cleft graft



The full cleft graft



The full cleft graft

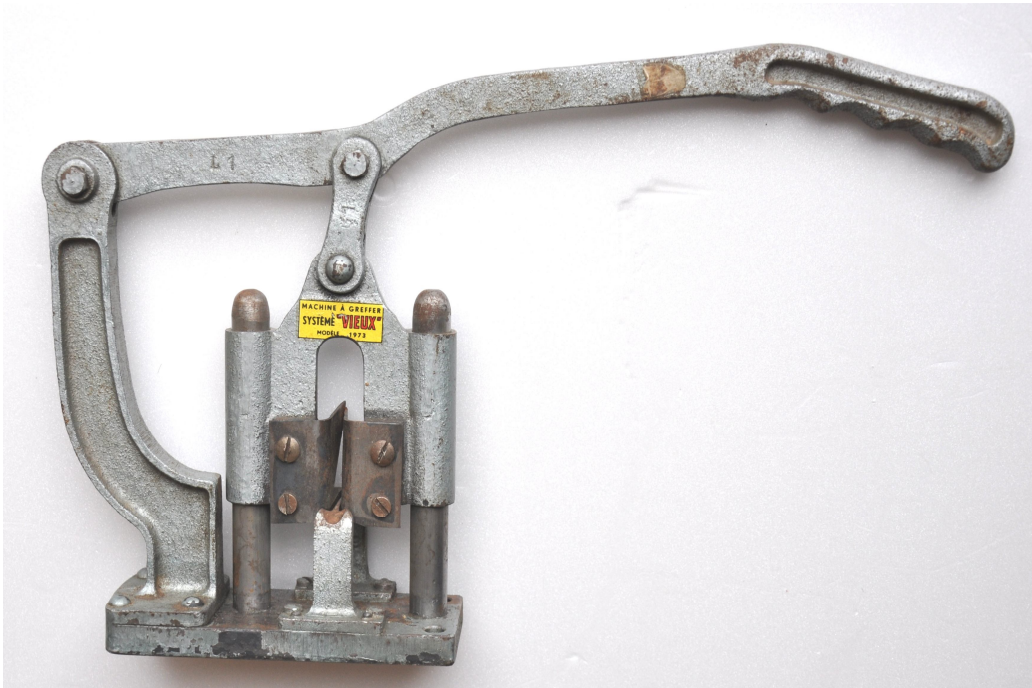


2 years old cleft graft





The « V » Graft



The « système
Vieux »



Bench or Field
Grafting

The graft-mortise



The T-bud Graft (Gargiulo & Bustos)



The Chip-bud graft (Snyder & Harmon)



A 5 and 20 years old Chip-bud graft





Hypertrophic
callus,
dead wood,
bottleneck,
interruption of
the
sap flow

Successful knittings : 20 years old top-grafting





Top-grafting and
Re-grafting limits:
The vine health
(virus diseases,
flavescence,
chlorosis).

Grafting and Top-grafting limits



Decline : Grenache noir



GRN Decline : longitudinal cut



GRN decline 2006 and 2011



Syrah disorder



Syrah disorder,
external vertical
crackings



Syrah Re-grafting, Portugal, France



Syrah disorder : non « declining » clones



Syrah disorder:
« auto-graft »

Grafting and wood diseases

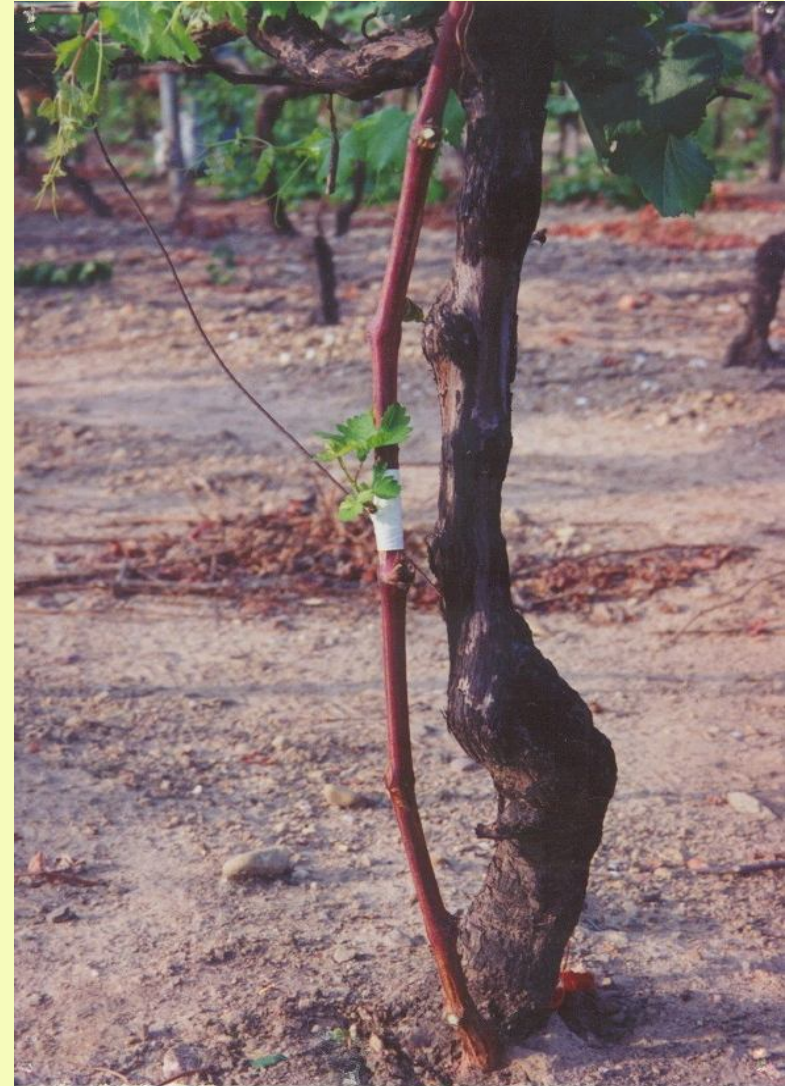
Esca

Rejuvenation

Wood rotting fungi



Interfering with frost or hail



Plot selection



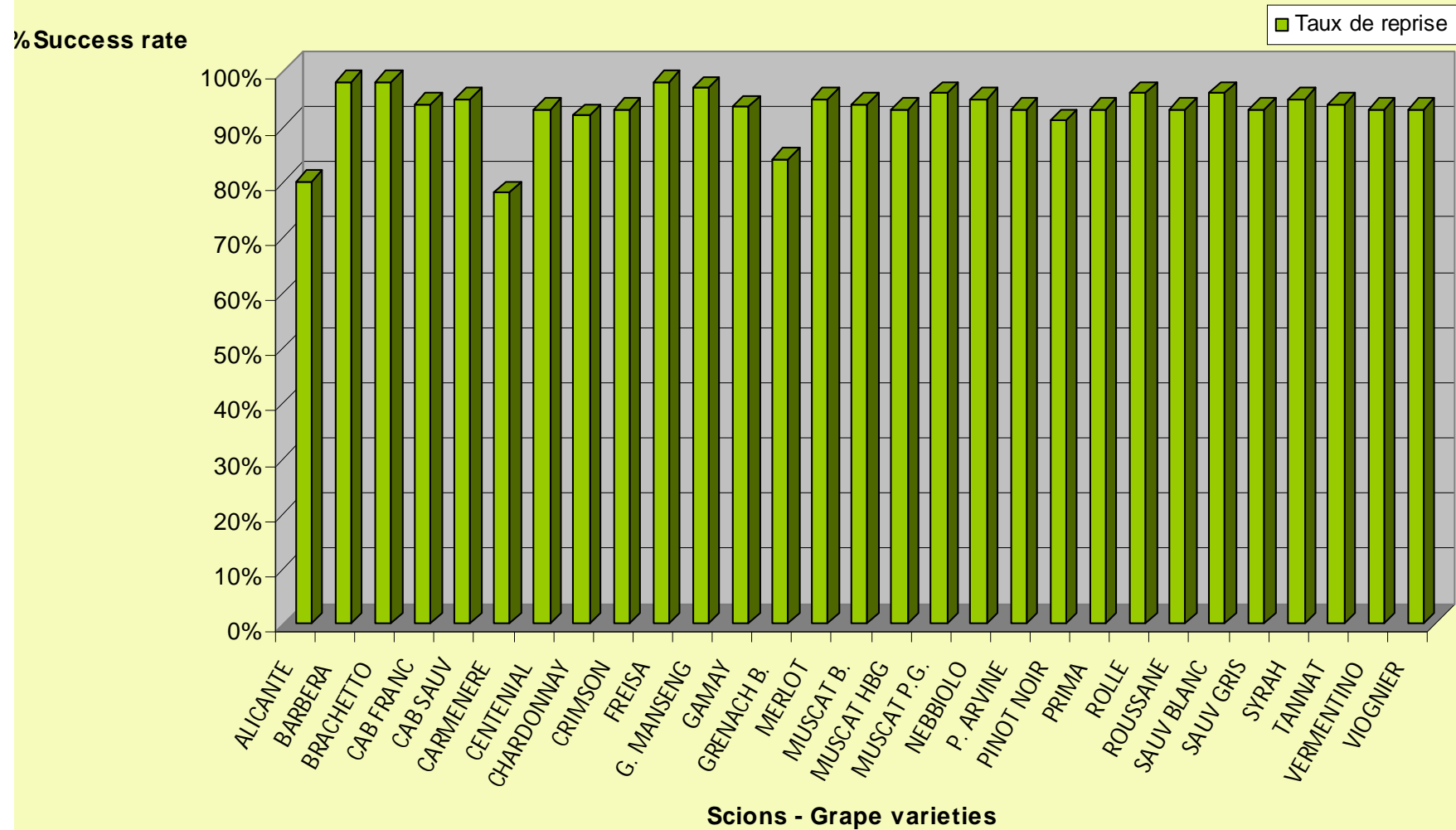
Clonal and massal selections



The future : « old way » techniques

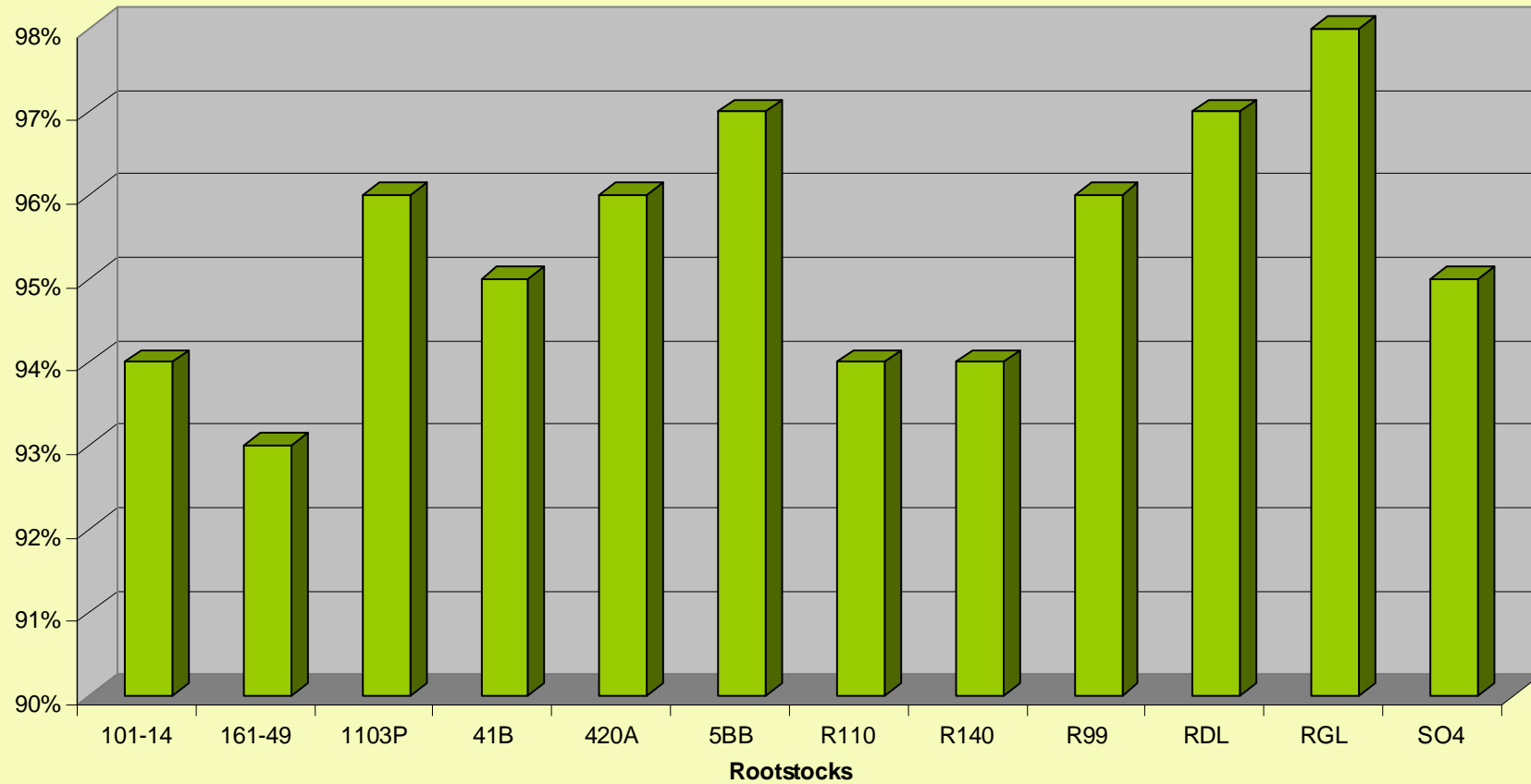


Success rates and grapes varieties



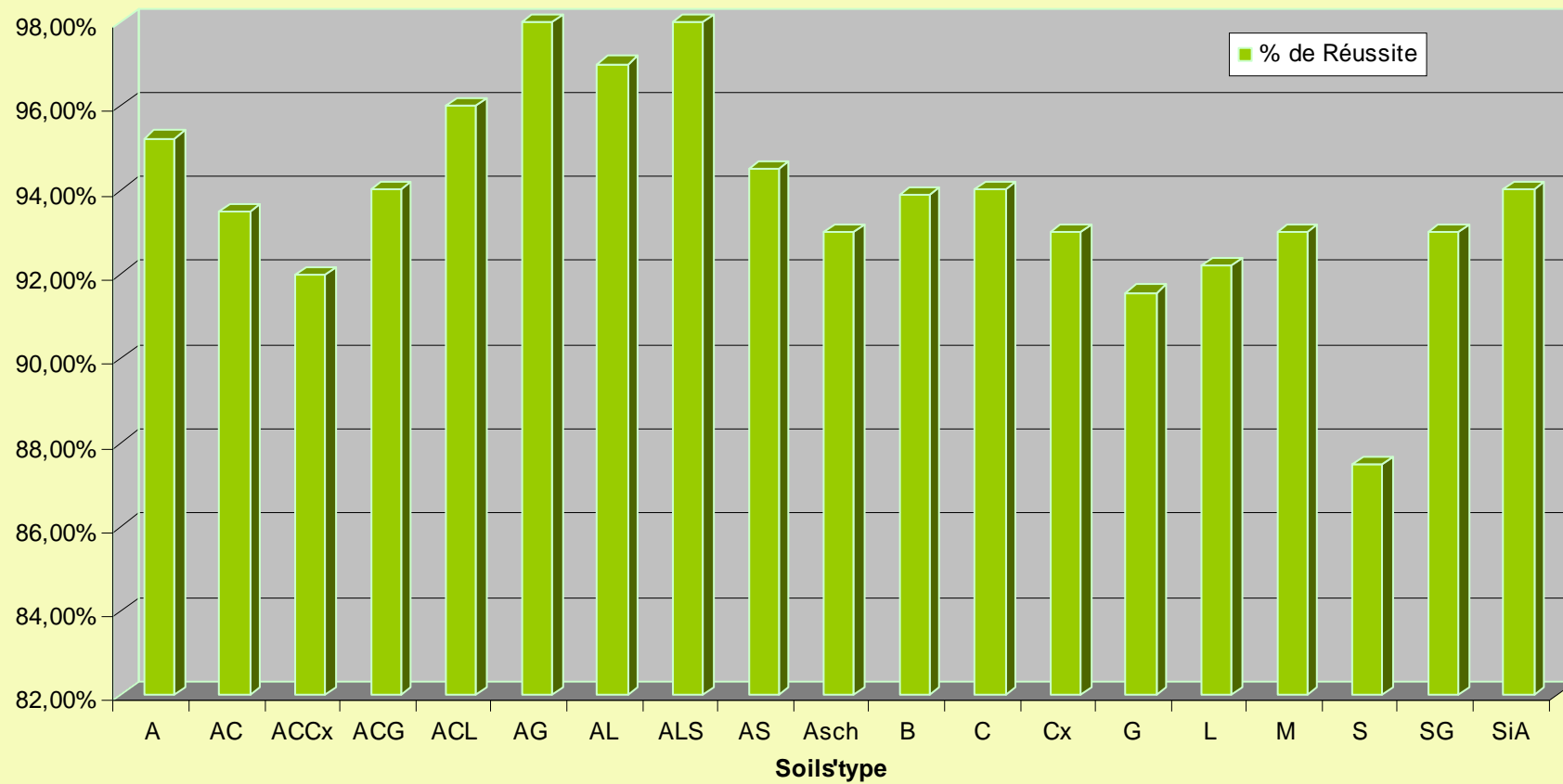
Success rate and rootstocks

Success rate %



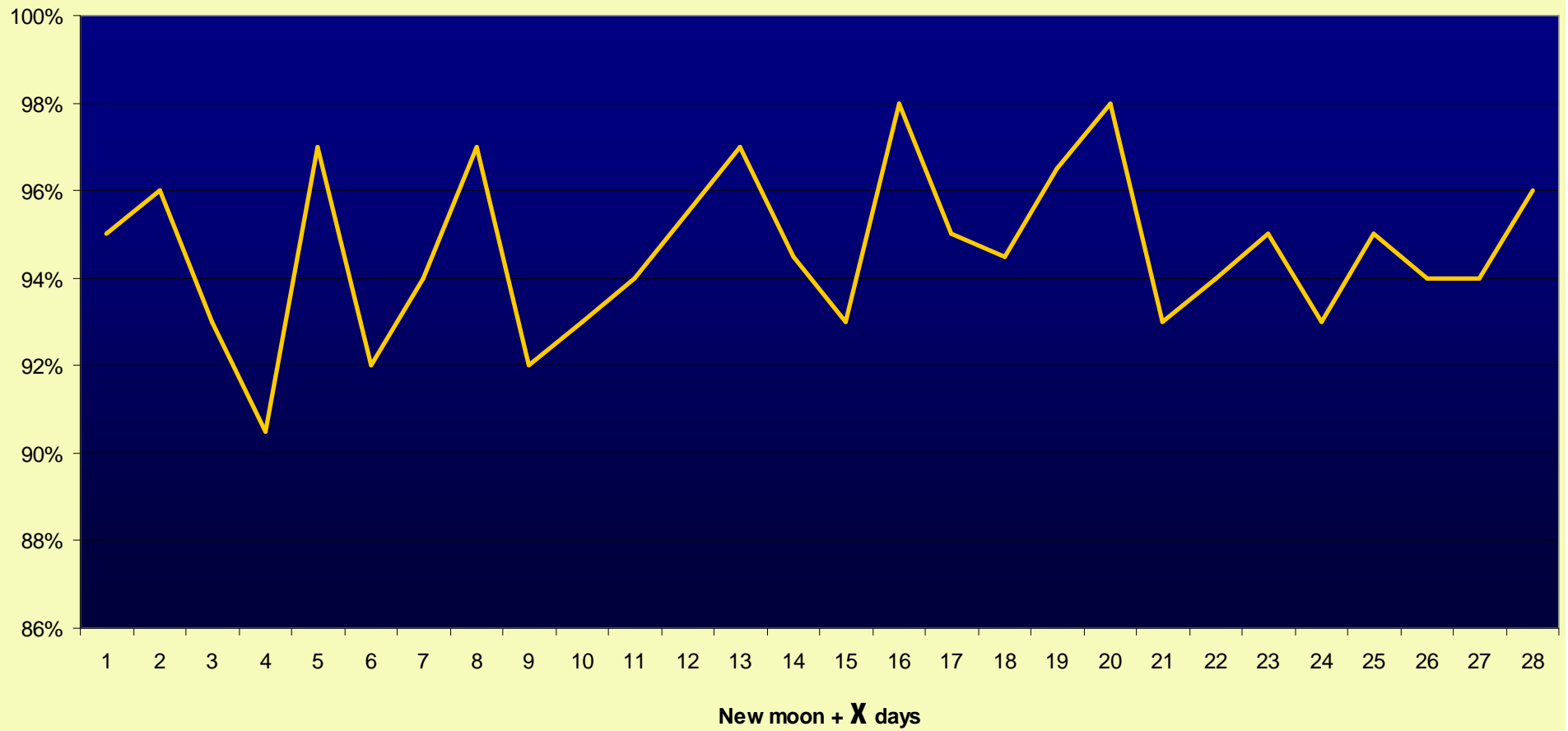
Success rates and soils

% success rate

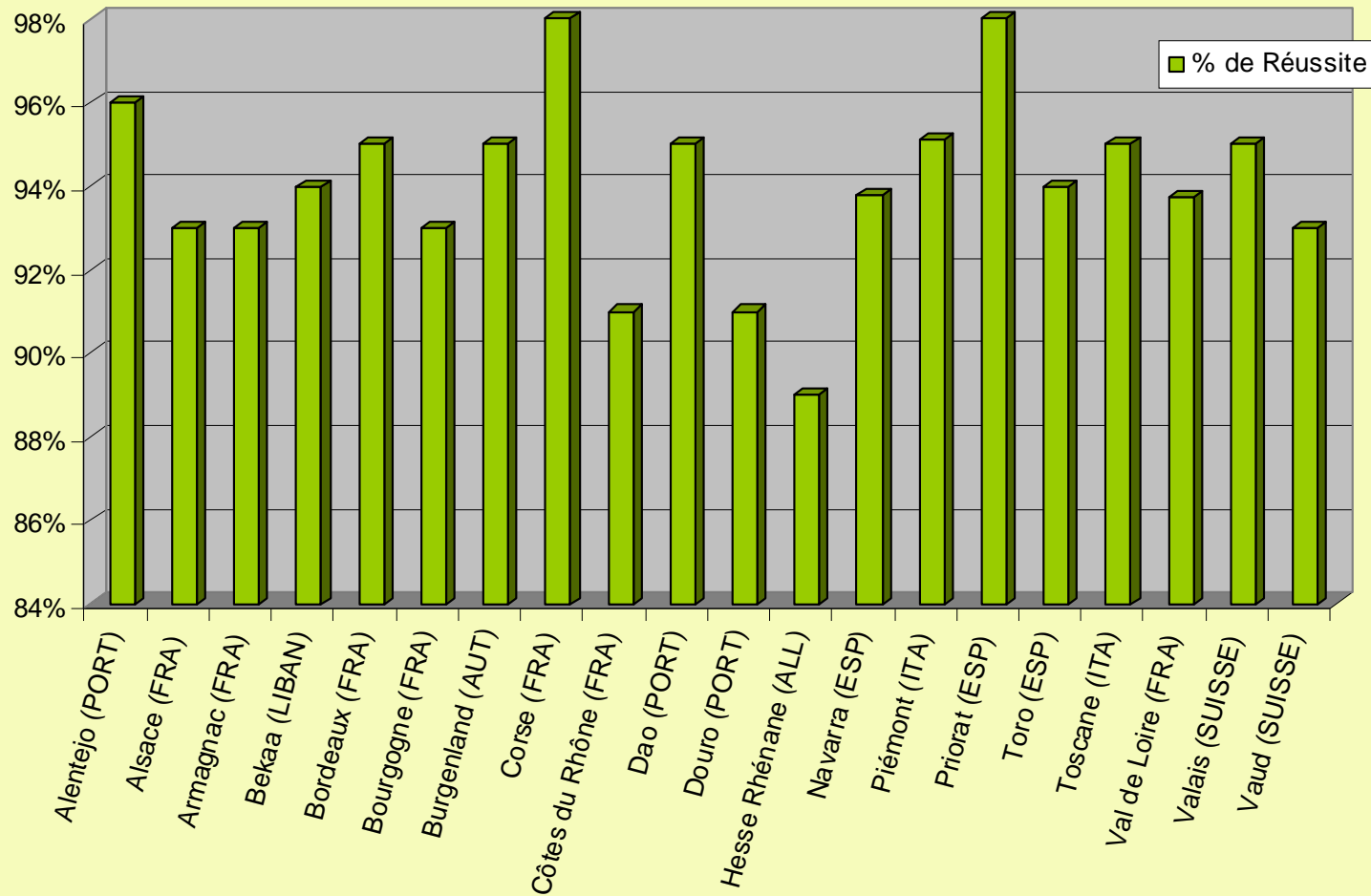


Success rate and lunar month

— % de réussite



Success rates and winegrowing regions



Success rates and grafting techniques

