MANUAL OF GOOD VITICULTURAL PRACTICES

DOURO DEMARCATED REGION

GOVERNO DE PORTUGAL
MINISTÉRIO DA AGRICULTURA, DO MAR, DO AMBIENTE E DO ORDENAMENTO DO TERRITÓRIO

IVDP, I. P.
Instituto dos VInhos do Douro e Porto, I. P.

CCDRN
Comissão de Coordenação e Desenvolvimento Regional do Norte

utad

INSTITUTO TECNOLÓGICO AGRÁRIO DE CASTILLA Y LEÓN
itacyl

CO-FINANCING:

PROGRAMA COOPERACIÓN TRANSFRONTERIZA ESPAÑA – PORTUGAL COOPERAÇÃO TRANSFRONTEIRIÇA 2007 – 2013

QUADRO DE REFERÊNCIA ESTRATÉGICO NACIONAL PORTUGAL 2007 2013

UNIÃO EUROPEIA
Fundo Europeu de Desenvolvimento Regional

Technical fact sheet

MANUAL OF GOOD WINEMAKING PRACTICES IN THE DOURO DEMARCATED REGION
SUVIDUR/POCTEP-EU Project
In partnership with the IVDP, CCDR-N, DRAPN, UTAD and ITACyL

EDITORS
IVDP, IP (Porto and Douro Wines Institute)
CCDR-N (North Regional Coordination and Development Commission)

TECHNICAL COORDINATOR
Nuno Magalhães (University of Trás-os-Montes e Alto Douro)

EDITORIAL COORDINATOR
CCDR-N Marketing and Communication Office

ENGLISH TEXT
Magdalena Gorrell Guimaraens

DESIGN, GRAPHICS AND PRODUCTION
Opal Publicidade

ISBN
978-972-734-282-2

LEGAL DEPOSITORY
350169/12

1st Edition
April, 2012

"SUVIDUR – Sustainable Steep Slope Viticulture in the Douro and Duero Regions", project co-financed by POCTEP (Operational Program for Spain-Portugal Transfrontier Cooperation 2007/2013) through the European Regional Development Fund.

MANUAL OF GOOD VITICULTURAL PRACTICES

DOURO DEMARCATED REGION

Wine is the end product of a long process that begins with the soil in which the vines that produce the grapes are planted.

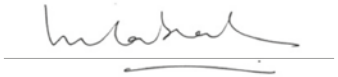
The characteristics of the soil, the slope of the land and its exposure to the sun, its capacity to absorb and drain water, the methods for planting and treating the vines, the trellising, all these and much more are essential to producing the quality grapes that are the primary condition for obtaining a good wine.

In the most ancient winemaking regions – and the Douro is one of the oldest of the most ancient – the farmer tends his vineyards as they have been tended from time immemorial. "This is how my parents, grandparents and great-grandparents did it and that is the way that I do it". Nonetheless, the methods for planting and training the vine, like the winemaking techniques, have progressed significantly in recent years. This is why we must learn from those who have studied these practices and be receptive to change – always with a view to improving quality and simplifying the procedures.

This Manual of Good Viticultural Practices for the Douro Demarcated Region, the result of close cooperation between institutions, depicts the best methods for planting and tending vines and vineyards and we thank the author, Professor Nuno Magalhães, for his dedication to this task. We would like to point out that a more detailed edition of this Manual will soon be available in a digitalized version. Also of interest is the widespread distribution, in the Douro Demarcated Region, of brochures written in a simple, very user-friendly language, whose purpose is to alert farmers – the primary beneficiaries of this work – to these good practices.

A farmer, regardless of the size of his vineyard, is an entrepreneur whose ultimate financial success depends on his use of the best technical and economic criteria. Past experience and present-day constraints, suggest that he must do better. To do better, to be more successful, does not necessarily mean spending more.

In this sense, this Manual is an instrument for improving the competitiveness of the region and as such, it is available to everyone whose viticultural activities contribute to safeguarding this universal landscape, the Alto Douro Winemaking Region, a World Heritage Property since 2001.



Manuel de Novaes Cabral

President of the Porto and Douro Wines Institute

Viticulture in the Douro Demarcated Region is an iconic activity that distinguishes this territory from other lands. The unique nature of Douro winemaking is an expression of the ethos surrounding the culture of vines and wine bequeathed through the centuries from one generation to another - a legacy created by the art of knowing how to transform the natural limitations of the land and craft the unique identity that is portrayed by the terraced hillsides.

The importance of safeguarding the authenticity and preserving the integrity of the features of an asset that UNESCO classified as a World Heritage Property, as well as the irrefutable value of this activity, called for a document that would provide practical guidelines for all the agents involved in the viticultural economy of the Douro Region.

The Manual of Good Viticultural Practices for the Douro Demarcated Region pays tribute to the undisputed uniqueness of this region's winemaking methods and cultural procedures, as it also celebrates the 10th anniversary of the Alto Douro's classification as a World Heritage Property. As an initiative under the SUVIDUR (Sustainability of Mountain Viticulture in the Douro and Duero Regions) project, this publication has garnered the cross-border attention that the topic justly demands. In this way, Portugal and Spain, through the IVDP (Porto and Douro Wines Institute) and the Instituto Tecnológico Agrário de Castela e Leão and the support of the Operational Programme of Cross Border Cooperation Spain-Portugal, bolster their role in protecting this common heritage as they act to safeguard a reality whose prevailing know-how has proven its worth as an indispensable added-value, without equal worldwide.

The very existence of this document is proof of the magnitude of the economic dimension of this activity and its social and cultural impact on the region, the scale of which has always been recognized by the CCDR-N (North Regional Coordination and Development Commission), principally through its Structure of Mission for the Demarcated Region of Douro.

Enfolded within this Manual is the labour that will benefit all those who endeavour to protect the Douro landscape and heritage. This initiative deserves a special acknowledgement for its contribution to the sustainability of a heritage that belongs to all of Mankind but, above all, to those who on a daily basis fashion and breathe this evolutive and living cultural landscape.

José Manuel Duarte Vieira

President of the North Regional Coordination and Development Commission

1.
PURPOSE AND CONTENTS

This Manual of Good Viticultural Practices is part of the SUVIDUR project for sustainable vineyards in the Douro Demarcated Region (DDR). Directed especially at viticulturists and winemakers in the DDR it is hoped that this Manual will also prove useful to individuals in the winemaking sector in other regions. The purpose of the Manual is to ensure compliance with the legal regulations and the standing guidelines for planting vineyards and training vines in the DDR, namely those set forth under PIOT – Intermunicipal Land-Use Plan that was developed after the Alto Douro Winemaking Region was listed as a UNESCO World Heritage Property and the PRODI – Integrated Vineyard Productivity Rules and Regulations, and to examine any technical constraints of these rules and their respective solutions. Integrated Vineyard Productivity aims at promoting the economically viable production of good quality grapes, primarily by using eco-friendly methods to minimize any undesirable effects to the environment and to the health of Man, as well as through the rational application of certified pest and pathogen control methods.

The objectives, in accordance with IOBC – International Organization for Biological Control guidelines, are as follows:

- Promote a viticulture that respects the environment, is economically feasible and in harmony with its multiple functions, namely those of a social, cultural and recreational nature;
- Ensure the production of healthy grapes and high quality viticultural products; reduce the amount of waste to a minimum;
- Protect the health of those who work in the vineyards;
- Encourage and maintain a great biological diversity within the viticultural ecosystem and in the surrounding area;
- Resort first to natural resources and regulatory mechanisms;
- Protect and promote long-term land balance;
- Minimize water, land and air pollution.

The Manual attempts to be as detailed as possible and consistent with the following fundamental goals:

- Define good viticultural practices for the different vineyard models;
- Compile and synchronize the legal and regulatory frameworks that apply to the DDR;
- Introduce the standards that govern the PRODI system and the respective norms, as well as other compulsory, permitted and recommended practices;
- Include, as attachments, details of pest and pathogen control products (fungicides, insecticides and herbicides) currently authorized for Integrated Pest and Pathogen Control, and their active substances.

The Manual also contains charts describing land and production methods, photographs illustrating the different vineyard models and flaws that may lead to land erosion and the respective corrective and preventive measures, as well as indications of methods for ensuring a more profitable use of manual and mechanical labour.

2.

GOOD PLANTING AND TRAINING PRACTICES

2.1. PLANTING A VINEYARD

A plan for creating a vineyard does not involve simply obtaining planting permission and complying with the applicable legal rules and regulations. It also requires a technical and financial plan containing details of how and when the various operations will be implemented and of the income and expenditure involved in the investment. The first fundamental step is to carefully prepare an economic feasibility study for the proposed new vineyard and to examine it from different aspects. Is this a totally new project or is it intended to increase an existing vineyard? What is the owner going to do with the grapes – will he use them to make his own wine or does he intend to sell them to another private entity or to a cooperative? In the first case, what is the area of the vineyard and the expected yield, as the varietals will have to be selected according to the type of wine the owner intends to make and where he intends to sell it, at what price and what added value after calculating the cost of the investment and the cost of production? In the second case, the owner should meet with the entity to which he intends to sell the grapes to determine which varietals he should plant, to estimate the yield he should expect from the vines, the price at which he can expect to sell his grapes, and the ideal time of the year he should deliver them to the winery so that he may have an approximate idea of when, each year, he should schedule the harvest.

The technical plan involves the following essential operations that will be required once the project has been approved by the competent authorities on the basis of the DRAPN and CCDR-N (Coordinating and Development Committee for the North of Portugal) opinions. The winegrower will have to:

- Select the exact location for the vineyard, taking into account the stability and safety of the hillside;
- Before proceeding with the planting, study the soil profiles to determine its suitability for viticulture and what actions, if any, are first needed to prepare the land;
- Draw a blueprint of the land showing the layout of the drainage and anti-erosion systems;
- Define the vineyard model, in accordance with the rules and regulations designed to protect the land from erosion;
- List the technical features involved in correctly creating or reconverting the vineyard in the form of patamares, vertical plantings or adaptations of traditional walled vineyards for mechanization by ensuring that tractors and other vehicles have access to and can circulate within the vineyard;
- Determine the method for training the vines and the minimum space between vines to comply with legal planting densities;
- Select the appropriate root stock according to the characteristics of the soil and the chosen varietals;
- Choose the vine varieties: varietals and clones, the percentage of each and their distribution in the vineyard according to how each is suited to the altitude, exposure and fertility of the soil;
- Choose one or more nurseries from which to purchase the root stock or the ready-to-plant grafted vines;
- Determine the characteristics of the posts and wire supports (wooden, metal or other posts, their height and thickness, anchorage of the end posts, attachment of the various accessories) – Consult with specialized providers of the materials that are to be installed;

- Select the contractor(s) to hire for building the vineyard and preparing the land, planting the vines and placing the posts, attaching wires and securing the end posts;

- Before planting and initiating any major corrective measures on the land, analyse the soil to detect the presence of nematodes and pathogenic fungi (see PRODI guidelines) and carry out chemical analyses of the soil essentially for the purpose of correcting the pH and adding organic matter and fertilizers if necessary, namely P, K, Mg and B;

- Prepare a schedule for the work involved in preparing the land for planting, including drainage systems, deep fertilization and planting;

- In the event that planting a new vineyard requires setting up an irrigation system, consult a company specialized in these systems within the DDR and apply for the system to be licensed by the CCDR-N, INGA and IVDP;

- Create a detailed timeline for each of the different operations and actions involved in the project.

2.1.1. CHOOSING THE LOCATION FOR THE NEW VINEYARD OR SMALL PLANTING OF VINES: RULES AND REGULATIONS, OFFICIAL STANDARDS AND GUIDELINES

According to Portuguese PRODI regulations (IOBC-WPRS guidelines, 1999), PIOT standards and the criteria of the current Scoring Method for Vineyards, as approved by Decree-Law 173/2009 of 3 August 2009 and Decree 413/2001 of 18 April 2001, vines for producing wine and oenological products must be planted in predominantly schistous soil, not excluding patches of originally granitic soil, recognized as capable of producing quality wines from vines planted in rows, low on the ground and trained along wires. The same criteria recommend planting vineyards in sheltered areas with a good exposure to the sun and that, whenever possible, the rows should run from northeast to southeast in order for the vines to make best use of the sunlight to produce sugars whilst, at the same time, protect the bunches from being scorched by the sun at its hottest; no vines should be planted in locations with poor drainage. It is worth remembering that the extremely rugged nature of the DDR topography and the great variations in altitude, exposure, slope and shelter make it exceedingly difficult to choose the best placing for the rows of vines, especially on patamares where there are constant shifts in orientation and exposure. These variations are substantially lesser in vertical vineyards where it is possible to define areas with a more or less constant and customized orography. The possibility of choosing the most appropriate orientation for the rows of vines particularly requires the knowledge of just how well any given varietal adapts to the various orientations and how the vines adjust to being exposed to the sunlight, most especially during the summer months.

Other compulsory rules, regulations and requirements include: a study of a drainage system that is compatible with the vineyard model is required for all vineyards covering more than 5 hectares of land or where the slope is greater than 20%; a vineyard where more than 10 hectares are continuously planted with vines laid out in the same manner must be clearly delimited by trees or vegetation on either side of the access roads and tracks; in the case of a vineyard that is continuously planted with vines laid out in the same manner over more than 15 hectares and in which traditional drainage systems and/or other assets are involved, the owner must arrange for a management program to be developed for the entire property.

2.1.2. SOIL PROFILES AND OTHER NECESSARY ACTIONS PRIOR TO PREPARING THE LAND

Before beginning any work on the land, except for all operations for clearing the land of brush, vines or previous crops when required, PRODI guidelines recommend digging trenches no less than 1m deep in order to examine the profile of the land. In the DDR, there is a predominance of leptosoil, virgin soil that has not been previously cultivated and that lies in thin layers directly on top of the schistous bedrock, and anthrosoil that lies in layers that are never less than 1m deep, created by Man when he destroyed rock as he scarified the land so that he could plant dendritic crops, in this case, vines. Also found in the DDR but not quite so frequently, are granitic soils that are considerably less suitable than schistous soil for producing Port Wine. The purpose of digging these trenches for soil profiles can vary somewhat according to the type of soil involved. In the case of the leptosoil that will be subject to a deep digging over, this thin layer of soil will be mixed with a much greater proportion of the soil created by the scarifying. As in practice there will be no horizontal layers of soil to examine as they do not yet exist, any such soil profile will not be possible. These trenches are dug for other operations such as for determining the friability of the soil and the orientation of the cleavage of the bedrock in order to determine the best way of digging the land, the type and power of the machines that will be required for this operation, whether dynamite will be needed for blasting large rocks and boulders that cannot be broken up by the machines, as well as what internal drainage may be required for any underground springs or for deep drainage.

In the case of the anthrosoil, as this has previously been cultivated and planted with vines, by examining the profiles in the trenches one can first determine the thickness of this layer of soil and whether any correcting is necessary, namely whether it requires additional digging over to improve the conditions for the vines. Secondly, the profile makes it possible to define different sub-layers whose physical and, especially, chemical characteristics may differ more or less widely. Soil samples for analysis need to be collected for each clearly visible sub-layer or at different depths (0-20cm; 20-40cm; 40-60cm) in order to determine what corrections (chemical or organic) and deep fertilizing may be required when preparing the land for planting. The results of these analyses may also provide useful information when choosing the rootstock and the type of varietal to plant in each section. When collecting soil samples, care must be taken to determine how similar they are, or not. When the land is not uniform in nature, it should be divided into homogeneous sections according to colour, texture, slope, drainage, previous crops, type of spontaneous vegetation in the case of uncultivated land, and other relevant features that distinguish one section from another.

With leptosoil, as the layer of the soil is very thin and it will be mixed with the remainder of the profile during scarifying, samples should only be collected after this operation to ensure that they are representative of the existing characteristics, although this will make it somewhat difficult to apply fertilizers and other correctives later on. Both types of soil should be mixed to a depth of approximately 50cm, which is where the greater percentage of thin roots will spread in the future. In the case of land previously planted with vines, PRODI guidelines recommend collecting soil samples down about as far as 50cm. In each sector, 15 to 20 basic samples, depending on their size, should be collected at random and in a zigzag fashion; after mixing them together and removing stones and roots, one should be left with a single sample weighing approximately 0.5kg. The guidelines stipulate the following analyses: pH (H20), ▶

- organic matter, phosphorus, available potassium and magnesium, manganese, zinc, available copper and boron, basic positive ions and cationic exchange capacity and granulometrics. Included in this list is determination of total and active calcium in the presence of carbonates, which in the specific case of the DDR is not justified as most of the soil is acid or close to neutral.

In the Upper Douro sub-region in particular, the levels of available calcium carbonate never induce chlorosis nor do they prevent planting rootstock that is more sensitive to iron deficient soil, such as 196-17 that is actually widely used in the region, especially in very poor, extremely stony soil. PRODI rules also state that soil analyses to detect the presence of nematodes and pathogenic fungi are indispensable whenever an earlier vineyard has shown signs of the presence of harmful microorganisms. In the event of a positive analysis, a 4 to 7-year waiting period must be respected before any further planting is authorized. The same rules strictly forbid the chemical disinfection of the soil to eliminate nematodes and/or pathogenic fungi.

When preparing previously cultivated soil for planting, the land should be cleared as soon as possible of all the roots of earlier vines and all possible sources of future, hard to control, infestations by shrubs, wild grasses and other rhizomatic or bulbous plants. These roots must be examined for the presence of fungi responsible for root rot (Armilaria mellea) and if present, burnt. The area should also be examined for moist patches where the fungus may have proliferated.

2.1.3. DIFFERENT VINEYARD MODELS

The models of steep slope viticulture that permit mechanization of vineyards are set out in the PIOT-ADV substantial strategic guidelines by Council of Ministers Resolution 150/2003 of 22 September 2003 and Joint Decree 473/2004 of 30 June 2004. These consist of horizontal patamares with natural embankments, more than 2.5m wide and planted with two or more rows of vines, of narrow patamares less than 2.5m wide and with a single row of vines planted on the outside edge of the platform, of micro-patamares consisting of small horizontal platforms, up to 1m apart, that follow the original slope of the land, and of vertical vineyards where rows of vines are arranged down the hillside according to the lines of greater slope, in the form of platforms each with the same degree of slope separated from each other by access roads built into the hillside at the top and at the bottom of each section of vineyard. In addition to these there are those that are applied when adapting densely-planted, ancient terraces separated by dry stone walls to mechanization whilst preserving the original landscape of the heritage area.

2.1.4. TECHNICAL ASPECTS OF STEEP SLOPE VITICULTURE AND EROSION PREVENTION

<u>General considerations to keep in mind for all steep slope viticulture:</u>

- Ensure the best and most effective use of mechanization and rationalize the planting operations;

- Maximize the balance between the desired yield and the quality of the grapes, namely by correcting the pH and the fertility of the soil, establishing the planting density, properly training the vines and determining the load (number of buds left at pruning), balancing the relationship between the amount of foliage per vine yield and the need to control plant vigour;

- Preserve the available water and fertility of the soil;

- Plant the vineyard so that it fits in as harmoniously as possible with the landscape, in line with PIOT-ADV guidelines for that part of the Douro Demarcated Region that is listed as a World Heritage Property and for the Specially Protected Area that corresponds to the remainder of the DDR;

- Safeguard the natural drainage lines and reduce the risks of erosion to a minimum, either by preserving "riparian culverts" and the natural vegetation at the top of the hillsides and on the slopes, or by creating "drainage channels" appropriate to the different ways that the vineyards are planted. Item 7.2.2. of Council of Ministers Resolution 150/2003 of 22 September 2003 regarding the PIOT-ADV, describes a "riparian culvert" as a linear structure composed of tree, brush and grasses that are proper to damp zones located along a 5m-wide strip on both banks of streams and water courses. The same Resolution defines a "drainage channel" as a structure that provides drainage of surface water from outside the vineyard or water that is not absorbed by the soil (superficial drainage), that drains excess water in the vineyard and lowers the water table, or that resolves problems when water rises to the surface when underwater streams are cut off (subterranean drainage).

Principal consequences of the incorrect laying out of the land for a vineyard and appropriate alternatives for minimizing erosion and making best use of mechanization.

Flawed vineyard layouts on the hillsides, often the result of mistakes or defects in the original design or a failure to supervise the work as it was done, are usually apparent in the inadequate use of the available land, the diminished effectiveness of certain viticultural operations, the decreased value of the product because of poor quality and the increased cost of production, as well as the negative impact this has on the landscape when standing PIOT-ADV guidelines are not complied with.

Defective layouts may result in more or less serious problems with erosion and these, in addition to the damage they are responsible for, are usually very expensive to correct. The effects of this erosion are expressed in several ways and frequently associated with each other: where the erosion creates gullies in the land, the thickness of the soil is diminished; when drainage of the surface water is not properly controlled, ruts will appear in the banks of the patamares or along the vertical plantings; sheet erosion, or landslips, will dislodge and drag the mineral elements along with them; as the soil shifts, there may be landslides that can damage the vines; mudslides and landslips that block water courses and open or hidden springs, in addition to aggravating the erosion and undermining the stability of the hillside, can block access to the vineyards and affect circulation.

Clearing the land on the top of the hill of all vegetation will also weaken the slopes below as rainfall finds it more difficult to penetrate the soil, thus resulting in landslips, ruts, runnels and gullies. The photographs in Figure 1 illustrate two situations that should be avoided. In one, patamares cover the entire slope, including the top of the hillside; in the other, although the top of the hillside has not been cleared of brush in order to prevent erosion to the patamares below, the vineyard arrangement has not respected the guidelines for preserving the principal water courses.

FIGURES 1A AND 1B - Two situations to avoid when preventing erosion. On the above, all the vegetation has been stripped from the hillside; On the below, although the vegetation on the top of the hillside has been retained to make it easier for rainwater to penetrate the soil, the major water courses have not been preserved.

FIGURE 2 - The natural vegetation at the top of the hill has been retained to make it easier for rainwater to penetrate the soil, as have the riparian channels along the water courses, thus preventing erosion by reducing the flow of water on the surface and the subsequent creation of ruts, runnels and gullies (Quinta do Ventozelo).

FIGURES 3A AND 3B - Examples of riparian culverts and streams in vineyards (Quinta do Ventozelo).

Figures 2 and 3 illustrate the correct way of controlling erosion on a hillside, both by maintaining the vegetation at the top of the hill and by conserving the natural water courses with riparian culverts.

An inability to make the best use of the labour, whether mechanical or manual, and the reduced effectiveness of certain viticultural operations may also be a consequence of the incorrect layout of a patamar or a vertical vineyard, as is the arrangement of the access roads next to or crossing a vineyard. In the latter case, in addition to making it difficult for tractors and other vehicles to circulate, the roads may worsen the erosion.

The most serious situations generally on found on patamares where extremely high embankments are also associated with extremely steep slopes (150-200%) that in themselves make it more difficult to control erosion, and on patamares where vines are planted in two rows which makes it more difficult and more expensive to control weeds and other forms of spontaneous vegetation.

FIGURE 4 - High, steeply-sloped embankments scarred by multiple furrows created by surface water due to the lack of an effective system for preventing erosion.

FIGURE 5 - Incorrectly formed patamares that, as they are not parallel to each other are supported by very irregular embankments in size and shape, will in turn create serious erosion problems and significantly increase the cost of the work in the vineyard.

FIGURE 6 - Two-row patamares correctly laid out (Quinta do Arnozelo).

FIGURES 7A AND 7B - Half-pipe concrete drains placed along the access roads to single-row patamares that slant along their length and inwards to encourage the rainwater to run down the slope and into the drains, thus preventing it from creating ruts and cutting into the embankments (Quinta da Romaneira).

FIGURES 8A AND 8B - On the left, a correct drainage system along a water course dating back to pre-phylloxera times; on the right, the same system after it was destroyed upstream to make way for mechanized patamares, resulting in serious erosion to the embankments.

2.1.4.1. WIDE AND NARROW PATAMARES AND THEIR EMBANKMENTS

After powerful bulldozers were introduced to the DDR in the 1970s because of the lack of manual labour, vineyards on the hillsides began to be laid out in the form of patamares with two or three rows of vines, supported by an embankment.
On hillsides where the slope is greater than 20%, patamares are generally planted with no more than two rows of vines 2.2 to 2.3m apart, on terraces that are no more than 3.8 to 4m wide. A lesser spacing of 2m is only permitted where the hillside curves so very little that tractors and agricultural equipment can circulate almost in straight lines, on patamares in the lowest part of a valley or where the hillside is convex. Thus said, depending on the amount of space needed by the tractors and other equipment, the distances between each row and the outer edge or the inner border of the patamar may vary from 0.8 to 1m and 0.6 to 0.8m, respectively. Sufficient space must be left between the inner row and the base of the embankment above it to prevent the path from being blocked in the event of landslips (Figure 10). On the other hand, the distance between the outer row and the edge of the embankment must be sufficient, not just for the passage of men and machines, but also to diminish the possibility that the roots of the vines might become exposed in the furrows created by the erosion.

FIGURE 9 - Wide patamares with embankments and planted with two rows of vines, crossed by access roads (Quinta do Arnozelo).

FIGURE 10 - Landslip blocking the path between the inner row of vines and base of the embankment above it.

FIGURES 11A AND 11B - Examples of correct and incorrect accesses between patamares and roads.

FIGURES 12A AND 12B - Building patamares strictly according to the contour lines of the land will create areas in which surface water will puddle and erode the embankments and the access roads.

- The total length of each patamar will vary greatly depending on the shape and size of the vineyard and also the type of machines and viticultural operations that will be employed, although it should rarely exceed 200m. It order to make the length of the patamares more practical, a network of roads is built across the terraces, not just to shorten them and thus cut down on time wasted with certain operations (refuelling spraying machines, for example) but also to improve the access for machines and to install a system for draining surface water alongside them (Figure 11).

Access roads must be a minimum 3 to 3.5m wide and slant no more than 10-15% down their length. On the surface, they must slant 2-5% inwards to ensure that surface water drains more efficiently outside the area or onto an open half-pipe concrete drains 30-40cm in diameter. In very large sections, instead of a single road, a network of roads arranged in a zigzag fashion and always with the recommended longitudinal incline, will be required to serve the entire vineyard.

When building a vineyard in patamares these must be as parallel to each other as possible and their embankments

as alike in height as possible. It is a mistake to lay out and build patamares strictly along the contour lines of the land as this implies a certain amount of landfilling that results in some areas being more banked up and more fertile in more sinuous areas and poorer in areas where the hillside is convex. Furthermore, as the height of the embankment along a patamar will vary greatly, it will be more difficult to control the vegetation that grows on them. Also, as surface water on a perfectly horizontal patamar will not easily drain naturally, there will be places where it will puddle and frequently be responsible for landslides and for carving ruts and runnels down the side of the embankment.

Lastly, by strictly respecting the contour lines and as the hillsides are very alike in terms of their profile, several "blocks" of patamares may have to be broken up in order to connect one to another (stand alones), thus increasing the amount of manoeuvring by the machines and reducing the efficiency of the viticultural operations. This can be avoided by inclining a patamar about 3% along its length and by ensuring that patamares are as parallel to each other as possible (Figure 13). ▶

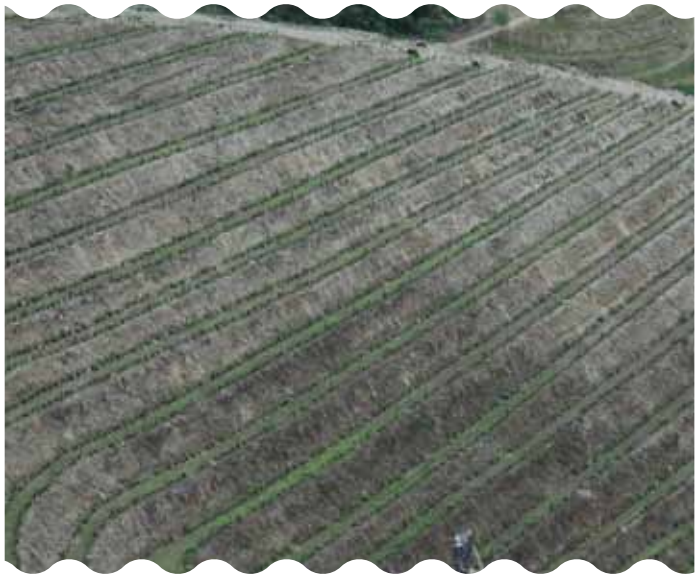


FIGURE 13 - Wide patamares sloping lengthwise, clearly showing how they lie parallel to each other.

FIGURE 14 - Patamares with 1 row of vines. Surface water flows down the longitudinal slant of the patamares and along the open concrete pipe drains and culverts on the access roads.

FIGURES 15A AND 15B - Narrow patamares whose horizontal surfaces are occasionally responsible for erosion to the embankments because there are no drains to carry the surface water down the length of the terrace.

Mechanization of a two-row vineyard on patamares is greatly restricted by the fact that machines only have direct access to the inner face of the wall of vines, which makes it difficult to use machines for fungal spray treatments or for shoot trimming. As it is more difficult for machines to reach the outer sides of the vines and the embankments, herbicides or manual work may have to be used to control the wild grasses and shrubs. In addition to this constraint, mechanical pre-pruning and canopy control become particularly restricted and less effective where patamares curve especially sharply. With this method also, the profile of the soil on which the vines are planted is not totally uniform as the earth on the inner side rests on an area that has been dug over whilst the soil on the outer side is essentially landfill and this makes for differences in the potential yield and maturation of the vines. An additional limitation to two-row patamares is the marked height of the embankments that varies according to the original slope of the hillside and makes it more difficult and more costly to control the wild vegetation, reduces the amount of land available for use in the vineyard and increases the risks of erosion.

An alternative method that is widely used to overcome the limitations and inconveniences of two-row patamares is to build narrow patamares with a single row of vines planted on the outer edge of the terrace, on landfill. These vines behave in

a more homogeneous manner than vines planted in two rows on wide patamares where one row is planted on landfill on the outside and another on land that has been dug over, on the inside. Generally-speaking, the patamar only needs to be 2.3m wide; a single row of vines planted 50cm from the edge of the embankment leaves a 1.8m-wide track for tractors. This width is sufficient for all mechanical operations on the vineyard as the track gauge of a tractor does not exceed 1.2m, the machines need at most 40cm between them and the vines when working and the tractor can circulate freely between the vines and the base of the embankment of the patamar above it.

There are significant advantages to this method of laying out the land as compared to two-row patamares: embankments are substantially lower and they can be easily accessed for plant control; fungal spray treatments can be easily applied to both sides of the vines and in certain situations one can treat the inner side of the row of vines and the outer side of those on the patamar above the track simultaneously; grass can be easily planted on the embankment to control erosion; and the greater homogeneity of the vines in terms of vigour, vegetative growth and productivity, together with more uniform rates of maturation of the grapes, contribute to improving the quality of the wine.

There are some drawbacks, however. All things being equal, the two-row solution may signify a greater number of vines per hectare and this could be important in extreme situations where there is a minimum density planting requirement, particularly in extremely high slope areas. This can be resolved either by reducing the distance between the vines and changing the training from a single or bilateral cordon to a simple or double Guyot, or by substituting narrow patamares with micro-patamares. Viticultural operations with offset tractors (pre-pruning and shoot trimming) that are not adapted to changing direction by turning in place are significantly less productive in the field as the tractor has to go back down the line without working before beginning on the next patamar, although today you can purchase suitable tractors. Structurally, narrow patamares are less stable during the first and second year after they are built and are prone to landslides following heavy rains, as compared to two-row patamares where the external part of the embankment contains some bedrock. Even when considering the future of the vineyard, patamares should still be constructed with a longitudinal slant of around 3% and slant inwards about 2%-3% in order to ensure the drainage of surface water, laid out parallel to each other and supported by uniform height embankments throughout, as illustrated earlier in Figure 7. We recommend the use of tractors fitted with laser guiding equipment to guarantee that the patamares are cut with the maximum precision.

FIGURES 16A AND 16B - Narrow patamares sloping 3% lengthwise and inwards so that the surface water flows down to the access roads, dramatically reducing erosion in these areas (Quinta da Casa Nova).

FIGURE 17 - A mechanized vertical vineyard with tracks for caterpillar tractors running from top to bottom, between the rows of vines (Quinta dos Aciprestes).

2.1.4.2. VERTICAL PLANTINGS

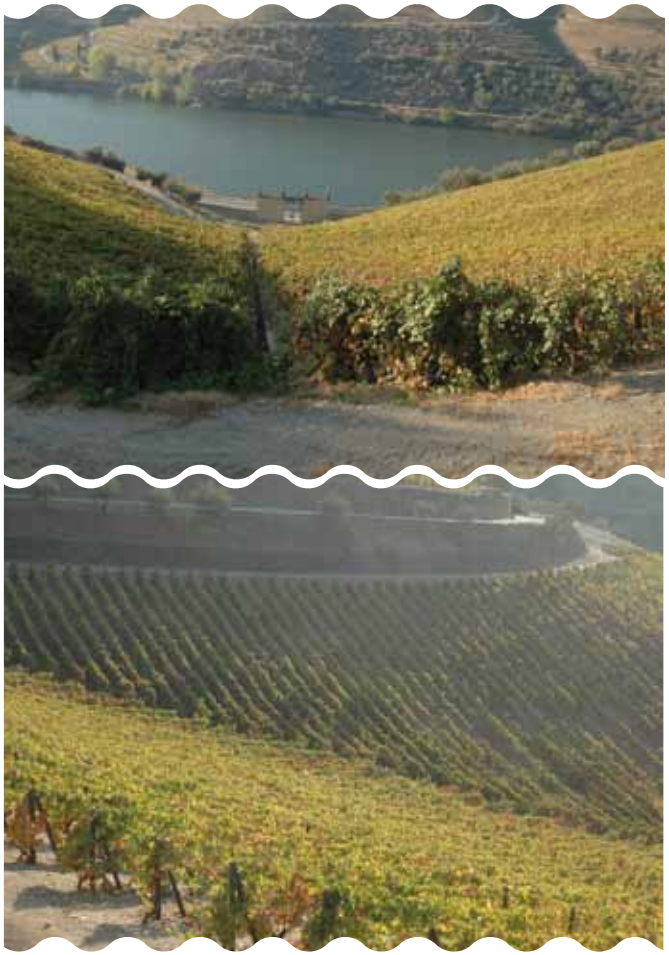
Vertical planting, the method used for creating a vineyard on very steep slopes and whose basic characteristics have already been briefly described, has certain significant advantages over the patamar method, particularly wide patamares, although it is neither practicable nor, according to PIOT-ADV regulations, legally permitted on slopes where the inclination is above 40% (30% in the Baixo Corgo Sub-region) 55-65H.P. caterpillar tractors were introduced into the DDR as the best machines for mechanizing these vineyards. In order to ensure that the tracks will grip the ground as they move uphill, these machines should be narrow, lengthened by attaching an additional roller at the back and weighed down in front with around 120kg. Wheeled tractors can be used when the slope falls below 20% and their principal advantage is their ability to operate at faster speeds during most viticultural operations. In vertical plantings, the vines are planted in straight rows from top to bottom, separated by paths along which the tractors are able move freely. The work is done more easily and more efficiently, particularly in the case of pre-pruning, canopy trimming and pest control, especially when the canopies have reached full growth and the tractors are able to spray the vines on either side simultaneously. As there are no embankments, the entire vineyard can be mechanized and used to the fullest extent; where the size of the vineyard warrants it, one can even resort to mechanical harvesting. Furthermore, as the platforms in vertical vineyards have a maximum 40% slope, as long as there is a proper network of drains there is a lesser risk of erosion than on patamares where the embankments may slope 200%.

Before the land is dug over, some reshaping of the land may be necessary in order to create planting platforms with uniform surfaces and better drainage. With this vineyard method, the land is dug over from bottom to top with the blade of a bulldozer, never less than 1.5m deep, to create a planting area where the soil has been turned over in a uniform manner at a considerable depth. During this process, part of the dose of the mineral potassium fertilizer will be mixed in deeply; the remainder will be spread over the surface with any lime that needs to be added to correct the pH and organic matter in the amount considered necessary. Once large stones and rocks brought to the surface by the bulldozer have been removed, the surface is evened out and the planting lines are drawn, always perpendicular to the contour curves of the slope. Because the orography of the hillsides in the DDR is so extremely rugged, in order to guarantee that the rows are as perpendicular to the curve of the land as possible (theoretically a maximum 5-10% off-centre to prevent the tractors from slipping sideward) mancas, or short rows, may have to be created either at the bottom or at the top of the planted area, depending on whether the land is concave or convex, or in cases where there is a sharp outcrop on the hillside, unattached patches separated only by a path for tractors to work and space to turn around.

In order to control erosion, the access roads at the top and the base of the sections of vineyard must slant 2-10% along their length to encourage surface water to flow outwards to the culverts and down the pipelines and 2-3% towards the inner edge to prevent water from running into the vineyard and creating serious ruts and runnels.

FIGURE 18 - Vertical planting. Example of an incorrect arrangement where a supporting wall at the bottom prevents tractors from moving smoothly along the paths and around the rows of vines.

FIGURES 19A, 19B AND 19C - Vertical planting – Placement of mancas, or short rows where the land is either concave or convex and unattached patches of vineyard used to guarantee that all lines are placed perpendicular to the curve of the land.



FIGURES 20A AND 20B - Vertical vineyard. Access road at the top of the vineyard and a drainage culvert along the water course (Quinta do Seixo).

2.1.4.3. SOLUTIONS FOR ADAPTING TRADITIONAL SOCALCOS TO MECHANIZATION

In addition to the new methods for building new mechanized, vineyards, the PIOT-ADV compulsory regulations for preserving the walls of the traditional vineyards and their horizontal terraces and the post-phylloxera terraces with their varying inclinations have led to solutions for adapting these whilst still maintaining the traditional structures of the vineyard (planting density, training of the vines and height of the posts and canopies) and preserving the old walls, the stone staircases connecting one level to another and the existing drainage systems.

One solution, illustrated in Figure 21, consists in building micro-patamares with a mini-swivelling tractor on each level, taking care to preserve the original supporting walls and the stone staircases. The mechanized work is done with narrow (0.8m-wide) machines especially designed for this type of narrowterraces whose width is no greater than 1.6m, of wich 1.1m is reserved for tractors to planting density is high and very similar to some of the traditional post-phylloxera vineyards, that is, between 5,000 and 6,000 vines per hectare for this specific solution. There is an access point for the tractor at each end of the mini terrace.

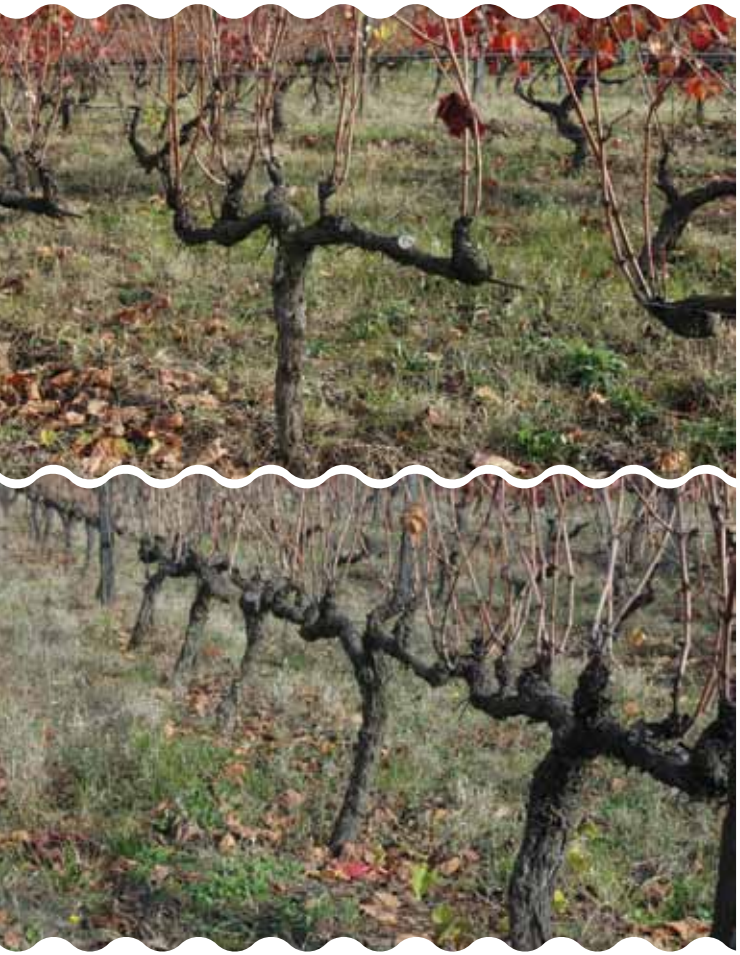
The varietals are planted together in lots, contrary to the random mixture that was usual in those vineyards.

Another solution, shown in Figure 22, basically consists of retaining the original walls, accesses, drainage systems and structure of the traditional vineyards, except for the manner of planting the vines that are now planted together in groups of single varietals. An access path about 1.8m wide is created on each terrace next to the upper supporting wall, wide enough for a tractor to circulate, to transport the grapes at the harvest, various viticultural materials and to carry out pest and disease control treatments where the product is sprayed onto the vines by a small cannon attached to the side of the tractor as it moves along the path. The vines planted in a row along the outer edge of each terrace should be protected by leaving 1.5m between the vines and the supporting wall, as any closer could lead to greater hydric stress and to scorching of the leaves and the grapes.

This method provides high planting densities and small yields per vine, important factors in the production of quality wines. There is also a considerably greater return from labour (number of man hours annually per hectare) than in traditional vineyards that cannot be mechanized.

FIGURES 21A AND 21B - Traditional terraces adapted to mechanization by creating micro-patamares (Quinta do Noval).

FIGURE 22 - Traditional terraces adapted for partial mechanization yet retaining the traditional structure of the vineyard (Quinta de Casa Nova).



FIGURES 23A AND 23B - Cordon Royat bilateral cordon. In the above photo, there is insufficient occupation by the vines of the available space. In the photo below, correct training of the vines.

2.1.5. BEST WAY TO TRAIN THE VINES, POSTS, MINIMUM SPACING OF VINES AND PLANTING DENSITY

According to Portuguese regulations and guidelines for implementing an Integrated Production in Viticulture program, in conformity with IOBC-WPRS (1999) guidelines and as set forth in Decree-Law 180 of 1995 and Decree 65 of 1997, vineyards destined for the production of wines and wine products in the DDR must be planted in rows, low on the ground, trained with wires, cane, cane and spur and cordon pruned, with a single fruiting zone. From an advisory viewpoint, those rules indicate that the pruning and training must allow air and light to circulate within the vine so as to reduce the incidence of diseases and that the training system (including the space between vines and rows) needs to be compatible with the leafing habits of the varietals, especially as regards vigour, to prevent the forming of very dense canopies that, by creating a microclimate that favours pests and pathogens, makes disease control more difficult and produces inferior quality grapes.

The training systems most used today in new mechanized vineyards are the bilateral cordon and the unilateral Cordon Royat and, to a lesser extent, the double or simple Guyot. With the bilateral cordon, the vines are spaced between 1.2m and 1.3m apart, in rows, depending on the typical internode distance for each varietal, inasmuch as the spacing between the nodes when they are formed will determine the greater or lesser spacing between the spurs on each branch. Generally, vines are pruned to three spurs or two nodes on each spur for an average total load of 12 shoots per vine. In the case of the single cordon, vines are usually planted closer together, about 0.9m to 1.1m between each. All things being equal, the load per vine is identical to that of the bilateral cordon and the shoots may be distributed as 5 to 6 on the branch that is led along the carrier wire or 4 to 5 on the cordon and 1 on the central stem 20 to 30cm below that wire. The latter solution has advantages in that the trunk can be renewed in case there are problems with the remainder of the plant, if some of the shoots are not sufficiently strong or if there are any diseases to the bark, or even offer the possibility that from that branch, change the way that the vine is being trained to more suitable method.

Generally, the fruiting areas along a row of vines are more uniformly distributed with the unilateral cordon, as compared to the bilateral training where, when the nodes are not evenly distributed during pruning, one frequently sees areas in which the foliage is denser, namely when the last shoots of a vine grow across those of the vine next to it and this is followed by other empty spaces (Figure 23). Regarding the Guyot method, traditionally very much used before new vineyards were adapted to mechanization, this is characterized by a fruiting cane located on the carrier wire, or two in the case of the double Guyot, with a 2-node spur for renewing the cane; the plants are usually planted 1m apart. Because the nature of the soil and the climate in the DDR do not great favour great leaf growth, like the Cordon Royat, rarely more than 6 to 12-nodes are left with the Guyot method. Where the vines are planted more closely together or in areas that are hotter and have little available water during the summer months, there may be even fewer. In vineyards with similarly fertile soil, plants and rootstock and in the absence of irrigation, the per vine load for any of the above systems will gradually diminish as one goes from the Lower Corgo to the Upper Douro, in accordance with the lower annual rainfall and higher summer temperatures.

There are marked advantages to the Guyot cane and spur methods and these are well adapted to the conditions in the DDR: although winter pruning may take longer and be more complicated than the characteristic Cordon Royat pruning, less manual labour is necessary during the growing season for shoot-trimming operations that, with the Guyot, are limited to pinching back side shoots from the main stem; the stem is less prone to diseases of the wood as it is not repeated nicked during pruning, which adds to the life of the vine; it is relatively easier to regulate the load on the canes left by the pruning, in accordance to the vigour of each vine; the trunk and the stems are considerably shorter than in vines with trunks and perennial cordons as with cordon methods, which enables to vine to adapt itself better to a great lack of water when irrigation is not possible; by reducing the spacing between vines, higher planting densities are possible and these, on more accentuated slopes, may be of considerable importance in view of the minimum legal planting densities. From the onset, the double Guyot is more balanced than the single Guyot, particularly because the canes are shorter, which on the one hand favours more efficient mechanical pre-pruning operations and, on the other hand, there is more uniform budding than with the longer single Guyot where there may be signs of apical dominance.

In very vigorous varietals sensitive to bunch twisting, both with the double and single Guyot method where the cane or canes are, respectively, led horizontally along the carrier wire or do not arch or buckle, either because of the torsion to which they are subject as they are trained or because of their horizontal position, we note a significant decrease in the vigour of the shoots, which improves the structure of the canopy and has positive effects on the quality of the grapes and the shape of the bunches.

A good design for the physical structure of the trellis that will support the grapevines and their foliage is essential, not only in terms of its strength and longevity but also in terms of permitting the rapid and effective orientation of the shoots so they can correctly capture the light, create an appropriate microclimate for the grapes to ripen, promote ripening of the grapes and facilitate disease control, as well as obtaining the best return from mechanized viticultural operations. The trellis system consists of the stakes, posts, wires or other structures that the vines are attached to and their fixtures. New mechanized vineyards usually employ treated wood posts or metal posts or a combination of both as an alternative to the traditional schistous stone posts (despite the fact that the latter are still sometimes used, especially when recovering ancient walled vineyards, with a view to respecting tradition and preserving the original landscape).

The intermediary wood posts that are generally employed are 6-8cm in diameter, 2.20m tall and placed every 6-8m depending on the spacing of the vines in the row. They are buried to a depth of approximately 0.60cm leaving 1.60m above ground, which is enough for a canopy to grow to a height of about 1.30m after the shoots have been trimmed. The end posts at either end of the rows are usually of a larger calibre, 8-10cm in diameter, and generally taller, up to 2.5m, to provide added strength to the trellis as all the longitudinal stresses are anchored on them. When metal posts are used they may be spaced in the same way, although it is recommended that wood end posts be employed as they are more resistant to the strain placed on them. When a combination of both is employed, in addition to the wood end posts, every third or 4th post may be wood (Figure 24).

FIGURE 24 - Trellising of a vineyard with a combination of wood and metal posts (Quinta de Vargellas).

FIGURES 25A AND 25B - Methods of anchoring an end post: Above, wood anchor with a tension wire; mobile wires with a turnbuckle; below, 2m-long anchor buried at 0.8-1.0m to reduce the strain on the end post and make it easier to move the double wires.

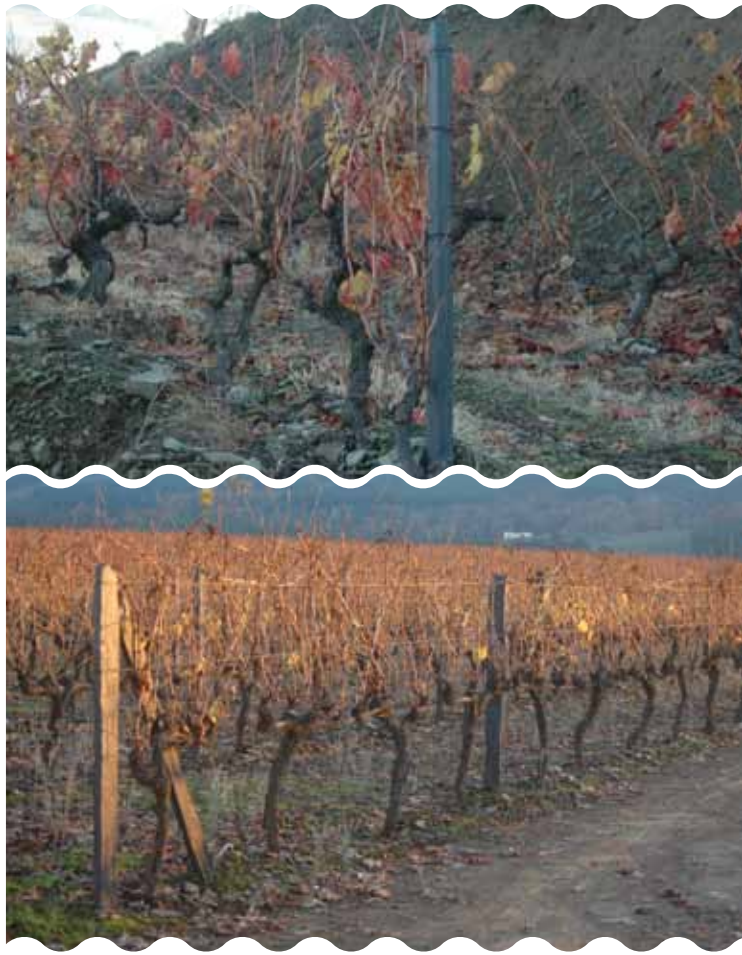
FIGURES 26A AND 26B - Examples of poorly-anchored end posts that reduce the tension on the wires and consequently make it more difficult to work on the shoots and perform mechanical pre-pruning.

- Rather than using zinc-coated galvanized soft iron wire for the trellis, we recommend stainless steel wire coated in zinc and aluminium as it is more resistant to corrosion and more long-lasting and free of iron residue that might lead to ferric casse in wine. The first, or carrier, wire (2 to 2.2mm thick) is fixed at about 0.60cm in order to guarantee sufficient height for the fruiting area. It is followed by a pair of movable wires and two single upper wires, or alternatively, two pairs of movable and a single fixed intermediary wire. Recently, some people have been substituting the double wires above the carrier wire with polyester string (DELTEX®) under tension as their elasticity makes it possible to lower them whilst the vine is dormant and to raise them once again when the shoots start to grow, thus reducing costs and rapidly increasing the speed with which this operation should be carried out. The mobility of the double stainless steel wires is likewise essential.

  The manner by which the end posts are anchored is of particular importance given the great strains to which they are subjected. There are several methods for doing this and the following are the most commonly used in the DDR: an anchor with a turn screw and tie-rod; a treated wood anchor brace; anchoring the post from outside the row with a piece of wood buried at a depth of 1-1.5m, some 1.5m distant from the last post, which not only decreases the strain placed upon the post because of its low height but also makes it easier to move

the double wires. With the first method, the wood post, buried at a minimum depth of 0.60m, is placed at a 70º angle outside of the row of vines. The anchoring wire is attached two-thirds of the way up the post and connected directly to the tie-rod, which itself is fitted with a 12 or 15cm diameter half-spiral device. A similar solution is shown in the left-hand photograph in Figure 25A, where the spiral device is substituted by a piece of wood 1 to 1.2m long, buried at a depth of 06. to 0.8m. The solution of a buried anchor, rarely used today, was nonetheless quite frequently used in vineyards with stone posts, as Figure 27B, and proved quite adequate. The last method, which is still in the experimental stage in the region, consists in burying a 2m-long treated wood anchor half-way up and about 1.5m from the last post so that at the same time it acts as an anchor, as a support and as a guideline for a pair of movable wires Figure 25B. The carrier wire is attached directly to the end post without any change in height; the double wire that was originally placed about 30cm above the first one and hanging on open hooks on all the posts, is lowered to the anchor post so that, once the pruning is over, it can be moved to its resting position below the carrier wire and later returned to its initial position, taking the shoots that have grown with it, to be quickly and easily attached; next, two simple, fixed wires are attached above this one and they also can be lowered from the end post to the anchor. Since the total length is less than that with the "traditional" end post, the strain placed on the end post by the wires is substantially lesser and it therefore does not require any additional anchoring.

Regarding the planting density, expressed as the number of vines planted per surface unit, spaced at a rate described in terms of the distances between each row of vines and between each vine in a row, Article 10, Item 2, Decree-Law 173/2009 of 3 August 2009 compelled the DDR to adopt a planting density of a minimum 4,000 vines per hectare, with a 10% tolerance, except in exceptional cases of vines on patamares and terraces where the minimum may be 3,000 vines per hectare, with a 20% tolerance. In accordance with this same Decree-Law, the concept of area is defined as the horizontal plane. At a later date, to take into account that vineyards might be created on relatively steep slopes, the legislation added a 20% tolerance to the last amount, which can be taken as permission to plant 2,400 vines per hectare on narrow or wide patamares under certain circumstances. Even so, when in certain specific situations it is difficult to plant these many vines, one has to choose whether to reduce the width of the patamares to the minimum size that is compatible with mechanization and/or to also decrease the spacing of the vines. In this case, one should choose for Guyot training methods that, because of their height, make it possible to reduce the space to as little as every 0.8 to 0.85m, less than is that necessary for Cordon Royat.



FIGURES 27A AND 27B - Incorrectly anchored end post (above); correctly anchored end post (below).

TABLE I – Chart for calculating the number of vines per hectare according to the slope of the hillside and the width and height of the embankments, for patamares with one and two rows of vines.

Slope %	Width of the embankment(m)	Height of the embankment(m)	Number of vines per hectarea	Slope %	Width of the embankment(m)	Height of the embankment(m)	Number of vines per hectarea
20	0.54	0.81	3,962	20	0.3	0.52	3,081
25	0.75	1.05	3,810	25	0.38	0.67	2,981
30	0.88	1.31	3,657	30	0.48	0.83	2,882
35	1.07	1.6	3,505	35	0.58	1.01	2,783
40	1.27	1.91	3,352	40	0.68	1.19	2,683
45	1.5	2.25	3,200	45	0.8	1.39	2,584
50	1.75	2.63	3,048	50	0.92	1.61	2,484
55	2.03	3.04	2,895	55	1.05	1.84	2,385
60	2.33	3.5	2,743	60	1.2	2.1	2,286

LEFT-HAND COLUMN – 3.5m-wide platform with 2 rows of vines, spacing 2.0 x 1.1m, slope of embankment 150%.
RIGHT-HAND COLUMN – 2.3m-wide platform with 1 row of vines, distance between vines 1.1m, slope of embankment 175%.
ADVID, November 2004

Table I, developed for a 1.1m spacing of vines in rows, shows how when the slope is above certain values, one has to resort to the narrower spacing in order to comply with the minimum planting density requirements. Decreasing the spacing between vines may also be effected by adopting other measures that are currently being studied such as a Guyot with a vertical axis and a single cane, as long as their effectiveness and viability can be proven and they are approved by the appropriate authorities. According to Article 10, Item 5, Decree-Law 173/2009, the IVDP may, experimentally and without losing the Denomination of Origin entitlement, authorize certain viticultural practices that represent an advance in viticultural techniques when these can be proven not to damage either the quality of the grapes or of the wine they make.

When it comes to vertical vineyards or vineyards on micro-patamares, the problem of complying with a minimum planting density does not arise because with the spacing used with these systems planting density always will always be greater than 4,000 vines per hectare due to the absence of embankments in the first case and very low embankments in the second.

Planting density is of great importance in viticulture inasmuch as it affects and determines which solutions are found for mechanizing various viticultural operations during the cycle of the vine and manual operations as well; it also has an enormous influence on the vigour of the vines, on yield and on the quality of the grapes and the respective wine. The greater the planting density, the less the amount of soil available for each vine and the lower its productivity. Generally speaking, vines whose individual productivity has decreased because of increased planting density, as long as provided with adequate shoots, are associated with higher quality wines. On the other hand, with low planting densities the yield per vine is higher but more irregularly distributed within each vineyard, which makes it more difficult to control the quality of the grapes. In this respect, one of the limitations of the patamares, especially the wide ones, is precisely the low planting density as compared to traditional vineyards and to vertical vineyards where the planting density is sometimes double that of the patamar. Of the features of the planting density, the one that has the most effect on the vigour and productivity of the vines is their spacing in the row rather than the spacing between rows. With a view to minimizing the effect of the low planting density on the patamares when one is looking to improve the quality of the wine, reducing the spacing between vines together with a compatible training method could provide a solution.

2.1.6. ROOTSTOCK AND VARIETALS

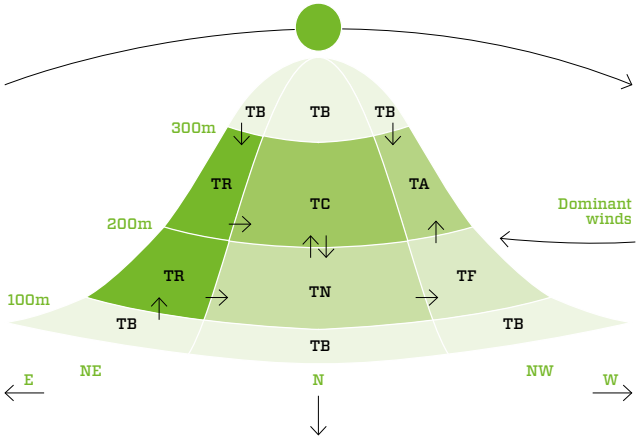
According to PRODI guidelines, dormant canes from which buds are taken for grafting in new vineyards must be examined and acquired from certified nurseries; rooted cuttings intended for planting ungrafted or rooted grafts must always belong to the same category as the certified material (blue label). A superior category for the basic material (white label) is also permitted although not justified in commercial viticulture as it is more expensive, although it may be occasionally used. Under Council Directive 68/193/CEE, the propagation material may be classified according to the rules of certification as basic, certified or standard material. Rooted grafts consisting of basic material grafted onto basic material or of basic material grafted onto certified material are classified as basic material, such as when the rootstock is certified and the scion is basic. Rooted grafts consisting of certified material grafted onto basic material or of certified material grafted onto certified material shall be classified as certified material, such as when the scion is certified and the rootstock is either basic or certified.

All other combinations, such as when the rootstock is certified or basic and the scion is of a non-certified or clonal origin, are classified as standard material. The latter situation results from the fact that there do not yet exist approved, or certified, clones for all the Portuguese varietals. Meanwhile, in the absence of certified rooted grafts for a given varietal, in new plantings we recommend recourse to clones of varietals that have been submitted to clonal selection and possess proven identity and purity (nonexistence of viruses), available from some nurseries as Polyclonal (POLIC) material.

The correct selection of rootstock is extremely important inasmuch as it helps improve productivity conditions under different environmental circumstances, depending on how each varietal performs and the purpose for which the grapes are grown. To ensure this, one must first analyse the soil to determine its texture in terms of coarseness and permeability on the one hand, and the pH and chemical content on the other. This must include the percentage of organic matter and most particularly the percentual values of basic positive ions, cationic exchange capacity and degree of saturation, free aluminium and boron on the other hand. In addition to providing indications for deep fertilization and soil correction during scarifying, the result of these analyses will be helpful for choosing the rootstock according to its ability to adapt itself to the characteristics of the soil. Because most of the soil in the DDR is acid and contains low levels of organic matter, there is a deficiency of primary and secondary minerals either because of the low pH or the poor cationic exchange, there is a lack of boron, and in these cases the free aluminium inhibits the absorption of macronutrients, which is why correction of calcium values and the addition of organic matter is essential if one is to ensure that the vine is correctly fed in the future. Each plant's ability to absorb various nutrients is a specific characteristic of each rootstock. For example, it is known that 1103-P is sensitive to a lack of boron; 44-53 is sensitive to magnesium and has a greater ability to absorb potassium; 196-17 shows some tolerance to acidity and is drought-resistant; 420-A provokes a loss of vigour when it is planted in soil that permits it to adapt; R99 and R110 boost productivity and the latter is particularly drought-resistant and less vigorous than 1103-P. Although it is indispensable to correct the soil before planting, one must likewise know exactly how each variety of rootstock will behave.

In addition to the characteristics of the Douro soil, another significant feature to consider when choosing rootstock is the climate that, although it varies from one sub-region to another and according to the altitude, is more or less similar to a Mediterranean climate where a cold, wet season is followed by a very hot summer with almost no rainfall. Generally speaking, therefore, one should choose rootstock that is resistant to drought and to poor soil and whose root system tends to penetrate deeply into the soil, namely that related to Berlandieri x Rupestris. Lastly, in addition to a rootstock's ability to adapt itself to the characteristics of the soil, although situations where there is a particular affinity with the various varietals are very rare, when implementing a viticultural project it is extremely important that one has the best possible knowledge of the specific qualities of each biological unit, or bionte, when comparing it to the characteristics of the terroir and the intended production objectives (quantity and organoleptic characteristics of the wines to be made). In other words, pay attention to the interaction between the rootstock and the varietal to see whether it is complementary or hostile in terms of vigour, productivity, resistance to drought or moisture in the soil, to the duration of the vegetative cycle and the corresponding precocity of the ripening, or capacity for absorbing certain nutrients.

Distribution of 6 varietals on a South-facing hillside.



TB - Tinta Barroca
TF - Touriga Francesa
TN - Touriga Nacional
TA - Tinta Amarela
TC - Tinto Cão
TR - Tinta Roriz

Distribution of 6 varietals on a North-facing hillside.

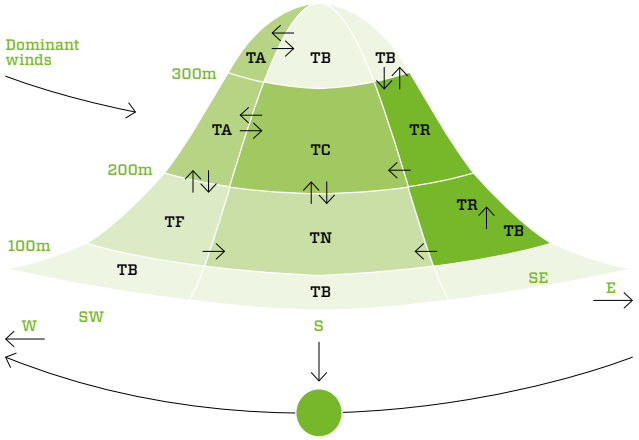


FIGURE 28 - Examples/suggestions for planting 6 varietals according to their performance and ability to adapt to the various orographic conditions in the DDR. Source: Oliveira A.A (2001) - Bol. Informativo da CIRDD, nº5

When it comes to choosing the vine varieties (varietals and respective percentages) for a new vineyard in the DDR, one must first of all respect the recommended or authorized varietals for DOC Port Wine and DOC Douro, as set forth in Decree 413/2001 of 18 April 2001, under the terms of Item 8, Number 2 of Decree-Law 173/2009 of 3 August 2009. Nevertheless, the fact that a varietal is officially authorized for planting in the Region does not mean that it can be used or planted indiscriminately. Because of the generally different ways by which that each varietal adapts itself to the environment (slope, exposure, altitude, fertility of the soil and more or less favourable conditions for attacks by pests and pathogens), one must first map out the land that is to be planted in each specific situation in order to plant each varietal where it will be most likely to produce the desired productivity and quality grapes. Equally important is to determine what one intends to do with the production: will the grapes be sold or will they be made into wine? What kind of wine: Port, DOC Douro, sparkling wine, other?

PRODI guidelines suggest careful consideration of the following precepts:

- "The chosen varietal or varietals should permit, under the soil and climate conditions to which it or they will be submitted, an appropriate amount of ripening, in most years, without this causing any significant (equal to or less than 10%) damage to the quality of the grapes in the form of wrinkling, raisining or rot";

- "Sections of the vineyard must be planted in groups of single varietals so that each varietal can receive the specific treatments it needs in a timely manner";

- "Sections of vineyard less than 1 hectare in size should preferably be planted with a single varietal. In cases where the winegrower intends to plant more than one varietal in a section he should first ascertain that each has an identical ripening season and a similar sensitivity to pests and pathogens." The size of each section or varietal planting and its potential productivity must be related to and programmed according to the intentions of the recipient entity as regards amounts and eventual scheduling of deliveries of the product; if he intends to make his own wine, according to the size of the winery and the vinification tanks so as to enable winemaking separate lots over the shortest period of time;

- "In locations that are frequently subject to late frosts one should choose late-budding varietals." N.B. In the DDR, these locations can be found at its limits at high altitudes and in sheltered areas or where the soil is more humid; no grapes should be planted where the risk of frost is high;

- In unsheltered areas one should choose varietals that are least sensitive to wind" and use trellis systems where the structure and the mobility of the double wires permits quick and effective action during the growing season, particularly when the shoots are first tied down.

2.1.7. CORRECTING AND FERTILIZING THE SOIL AT THE PLANTING STAGE

As mentioned earlier, depending on the results of the analyses of the soil, conditioners and fertilizers may need to be added to ensure that the vines will develop in an environment that promotes levels of productivity corresponding to those considered admissible by the regulations for the Region, as well as a balanced vigour favourable to the production of ripe and healthy quality grapes. The amount of each fertilizer can

be determined by the laboratory technician or calculated according to the PRODI guidelines, in accordance with Tables II and III.

The overwhelming majority of the soil in the DDR is poor in organic matter, yet although the needs of the vine are relatively minute as compared to other crops, organic conditioners are recommended whenever the organic matter content is below 1% and compulsory when the pH is below 6.0 (H20) and usable copper is greater than 20ppm with a low or very low organic matter content. In Integrated Production, it is not advisable to apply more than 30 tons of well-seasoned cow manure, or equivalent organic or organo-mineral conditioners. As regards the application of Solid Urban Waste (SUW) as a source of organic matter, its use in Integrated Production is only permitted in the case of high quality tested products. Also regarding the use of sewage sludge, treated according to currently applicable legislation (Decree-Law 446/91 of 22 November 1991 and Decree 176/96 of 3 October 1996).

Considering that the soil in the DDR is generally acid, calcium and magnesium from different origins are usually used to correct the pH when planting a vineyard. Calcium correction is indispensable in soil lacking in CaCO3 and with a pH (H20) <5.9 and a less than 50% saturation of the base elements. The quantity of lime that needs to be applied can be calculated on the basis of the pH, in doses that will depend on the values of the organic matter (%) and the texture of the soil. The amount of liming must also be adjusted according to the respective alkalizing power and available Ca2+ and Mg2+, when choosing to use calcite (when sufficient Mg2+) or dolomitic lime (when there is a lack of Mg2+). When using fine grain lime, one should apply 1 to 3 Kg/ha of boron in order to compensate for any blocking of this element by iron and aluminium hydroxides whenever the pH rises to alkaline levels, which could lead to a boron deficiency. In the DDR, fertilizing based on chemical fertilizers generally includes adding phosphorus and potassium across the land, but rarely magnesium, as when this is justified, it is done in the form of dolomitic lime whenever one has to correct the pH and always when there is less than 60 ppm of Mg, whether the degree of saturation of the base elements is below 50% or whether the relation between the K+ and Mg2+ ions is greater than 4, in this case regardless of their value as, even when they are present in adequate amounts, their absorption is inhibited by the relatively higher potassium values.

Mineral nitrogen should not be added before planting because it leaches deep into the soil and is of no use to the vines. After planting, however, when the roots of the plants are sufficiently well-established, one might wish to make local applications in the order of about 50g of a nitrogen-nitrate, nitrogen-ammonia or urea fertilizer in a maximum 1% solution, per vine. In any case, PRODI regulations prohibit applying more than 10 to 15Kg per hectare. However, if correction with organic matter is necessary, nitrogen can always be incorporated in different forms where it may be released immediately or more or less slowly.

Organic or mineral correctives are spread over the surface after the soil has been dug over by the bulldozer and later dug into the soil up to a depth of 40-50cm to reach the area with the greatest quantity of roots, bearing in mind that given the characteristics of the soil in the region the mobility of the calcium ion is greatly reduced and therefore does not correct the pH in the desired areas. Because of the conditions in the DDR, the adding of fertilizers, P and K especially, should be done partly whilst the soil is being dug over and partly spread over the surface once this has been done and then dug into the soil when the ground is levelled. The heavy nature of the soil also greatly restricts the mobility of these elements, which is why they cannot be added only on the surface as this would make it difficult for them to wrap themselves around the roots of the vines.

TABLE II - Levels of fertility of the soil according to P, K, Mg and B content.

Level of Fertility	Phosphorus P205 (ppm)	Potassium K20 (ppm)	Magnesium Mg (ppm)	Boron B (ppm)
VL	≤ 25	≤ 25	≤ 30	≤ 0.20
L	26 -50	26 -50	31 -60	0.21 – 0.60
A	51 – 80	51 – 80	61 – 90	0.61 – 1.20
H	81-120	81-120	91 – 120	>1.20
VH	>120	>120	>125	

VL – Very low; L – Low; A – Average; H – High; VH – Very High

TABLE III - Recommended amounts of phosphorus, potassium and magnesium to add before planting, according to the fertility of the soil.

Level of Fertility	Phosphorus P205 (ppm)	Potassium K20 (kg/ha)	Magnesium Mg (kg/ha)
VL	400	500	60
L	300	400	45
AM	200	300	30
H	100	150	0
VH	0	0	0

VL – Very low; L – Low; A – Average; H – High; VH – Very High

FIGURES 29A AND 29B - Examples of grass cover between rows of vines on patamares and vertical vineyards in the DDR (Quinta da Romaneira, above, and Quinta do Ventozelo, below).

2.2. PROCEDURES TO FOLLOW ONCE THE VINEYARD BEGINS PRODUCING GRAPES

As explained in the introduction, this Manual of Good Practices addresses the aspects of the legislation that regulates viticulture in the DDR, namely the PIOT, as well as the PRODI viticultural rules and regulations for the Region, inasmuch as they represent the most correct viticultural methods for sustainable viticulture.

2.2.1. SOIL MAINTENANCE

PRODI rules for soil maintenance prohibit the use of herbicides except for controlling weeds along the rows, occasionally for eradicating highly resistant infestations of perennial weeds and in old vineyards that are not laid out in rows. Still, not all active substances in herbicides are permitted under either Integrated Production or Integrated Pest and Pathogen Control guidelines; the list of authorized herbicides according to their chemical composition is attached to this Manual. The soil in the vineyard should not be tilled before the end of April or May each year, in order to protect the soil against erosion during the winter months and also to make it easier for the tractors to circulate whilst they treat the plants in the Spring. An alternative may be to maintain a grass cover, sown or spontaneous, temporary or permanent, or to cover the soil with straw. With a climate like the DDR's, permanent grass covers not only have the advantage of protecting the soil against erosion, they also improve its structure and fertility and as a mulch, act as a means of decreasing the evaporation of water from the soil during the dry summer months. Although herbicides are permitted on the rows, more eco-friendly measures would be to apply an inert material (pine bark, sawdust, straws, grape stalks, etc.) or to till the soil between the vines.

2.2.2. FERTILIZING FOR PRODUCTIVITY

Maintenance fertilization is used to keep the fertility of the soil at appropriate levels, to ensure that the vigour of the vines is well balanced so that there is an optimal relationship between the productivity of the vine and the quality of the grapes and to correct any eventual nutrient deficiencies. To do so, one must assess the state of fertility of the soil and the nourishment provided to the vines through regular analyses of both soil and the foliage; the results will indicate what fertilizers and soil corrections are necessary. These may be applied directly or by liquid manure spraying, or in more specific situations, through the leaves as, for example, for correcting nitrogen, potassium, magnesium, zinc and boron deficiencies, where there are evident symptoms of this, which does not dispense with later corrections to the pH of the soil and to existing levels of this element. Integrated Production regulations require soil analyses every four years and leaf analyses every two, although in certain situations leaves should be examined annually in order to ensure the permanent control of the nutritional condition of the plants and to act not just by adding fertilizers but through other viticultural operations (pruning, sowing of grass, liquid manure spraying, etc.). The results of the foliar analyses are judged by comparison to the reference values given in Table IV for PRODI guidelines. Table V can be used as a guideline for fertilization according to the different values of the nutrients.

Nitrogen should be spread on the surface before budding, at maximum doses of 5Kg of N per expected ton of grapes. When soil potassium is high or when the relation between the K and Mg ions is greater than 4, the amount of magnesium applied should be raised to a maximum 30Kg of Mg per hectare. Phosphorus, potassium and magnesium, given their degree of

mobility and the type of texture of the schistous soil, should be applied deep down in the soil. In granite soil, the remaining elements, except for phosphorus, can be spread over the surface and lightly raked in as they are very mobile in sandy-type soil. In both cases, however, fertilization with these elements must be done during Winter. Although boron, ought to be spread over the surface during Winter, it may also be provided through the leaves before flowering as it affects bud set and lack of boron may result in poor berry set, particularly in varietals that are particularly prone to poor bud and berry set and to hen and chicken in bunches phenomena.

When organic corrections are needed, these should be evenly spread over the soil and then dug in at the end of Winter and, according to PRODI guidelines, not exceed 10t per hectare per annum. "The amount of fertilization recommended by the laboratories that analysed the samples may, whenever necessary, be adjusted by the technician responsible for supervising the vineyard, as long as he does not exceed the maximum allowed doses. Such adjustments, particularly in the case of nitrogen, must be justified by recorded observations throughout the year (plant vigour, sensitivity to pests and pathogens, rainfall, etc.)."

New and installed vineyards are required to provide integrated sampling units in sections of vineyards that are representative of the dominant characteristics of the soil, topography, exposure, age of vines and viticultural methods, if they wish to access the PRODI program. Each sampling unit consists of 40 vines of the same varietal and rootstock from which the samples of land and foliage will be collected for analysis. Each soil sample is analysed every four years during the Fall or Winter and consists of 15 to 20 sub-samples taken from the top 50cm in each one of the three sections of the sampling unit. The following laboratory analyses are compulsory: pH (H20) and amount of lime to add if necessary, organic matter, and free phosphorus, potassium, magnesium and boron. In the case of vineyards that are sprayed with liquid manure, determination of the chlorides and the electric conductivity of the sample collected next to the drip feeds must be added to the aforementioned analyses.

As regards the leaves, their analysis is compulsory beginning when the vine is four years old and every two years afterwards. The leaf samples must be collected when the vine is in flower, during the morning or at the end of the day, as distant as possible from any disease control treatments. 15 to 20 leaves for each sampling unit must be picked with their stems from stalks located in the middle third of the branch and always opposite the basal bunch. The stems, once they have been stripped of the blades, have to be duly kept in a fruit and vegetable refrigerator and must be sent to the laboratory within a maximum 48 hours, packed in cloth bags, in nylon mesh nets or in perforated paper bags of the Lemon Kraft type. The leaves must be analysed for the following elements: nitrogen, phosphorus, potassium, calcium, magnesium, iron, manganese, zinc, copper and boron.

As regards manures and other organic correctives, when details of their respective composition are not indicated on the packages in which they are sold by certified companies, these must be analysed for the following elements: organic carbon, total nitrogen, total potassium, total calcium, total manganese, total zinc and total copper. The carbon/nitrogen relation is also important as this provides information regarding the degree of decomposition of the organic matter and the % of humidity. As for sewage products from treated solid urban waste (SUW) and whose use in PRODI is only permitted for products of recognized quality, it is highly desirable that, in addition to determining the parameters mentioned for manures and other organic correctives, one obtains values for the following heavy metals: cadmium, lead, chromium, mercury and nickel.

TABLE IV - Acceptable foliar mineral content values, measured in leaf stalks located opposite the basal bunch, collected when the vine is in full flower.

Nitrogen (% N)	Phosphorus (% P)	Potassium (% K)	Calcium (%Ca)	Magnesium (% Mg)	Boron (ppm B)
0.90 - 1.20	0.20 - 0.40	1.50 - 2.50	1.30 - 2.80	0.30 - 0.60	25 - 45

TABLE V - Recommended fertilization for vines producing wine grapes under Integrated Production (Kg/ha) conditions, based on the mineral content of the leaf stems located opposite the basal bunch from the previous year.

Nutrient	Content is too low	Sufficient	Content is too high
Nitrogen (N)	50 - 65	40	0
Phosphorus (P2O5)	40 - 50	25	0
Potassium (K2O)	75 - 100	50	0
Magnesium (Mg)	20 - 30	15	0
Boron (B)	2 - 3	0	0

2.2.3. DURING THE GROWING SEASON

These are the various viticultural operations that are carried out during the active stage of the vine's growing season with a view to creating and maintaining a balanced canopy for the passage of light, to boost vigour, favour productivity and create the best ripening conditions for the grapes. The following operations are usually carried out in this order: disbudding (may be repeated later, especially when the vines are trained in cordons or cane and spur pruned), training of the shoots according to the desired training method, shoot trimming (may be repeated once or more often depending on the characteristics and vigour of the varietal x rootstock unit, the training method and the fertility of the soil), leaf removal (when justified) and thinning of the crop (when warranted).

2.2.3.1. DISBUDDING

Disbudding (shoot removal) consists in removing superfluous buds that develop as basal or secondary shoots that because they are not usually fertile consume energy without contributing to the vine. All these buds are pinched off the trunk and branches and some buds at least, from the base of the spurs, especially on vines trained as a cordon. This operation must be performed as soon as possible after budding, not just because it is easier and quicker, but also because the less they are allowed to develop, the less the amount of carbohydrates stored in the form of starches in the trunk, branches and roots of the vines, they will consume. In the case of cordon systems this is a particularly time-consuming and prolonged operation, particularly in the case of vigorous varietals grafted onto equally powerful rootstock (Touriga Nacional on 1103-P rootstock is typical of this) where buds need to be removed from the base of the spur in order to open up that area and give the fruiting cane more room to breathe, improve access for disease control provide and better ripening conditions for the grapes.

Disbudding must be performed by individuals who are specialized in this type of operation and in winter pruning, as both are connected. With Guyot training, in which pruning is done on the shoots that grow from the spurs from the previous year and below the fruiting cane, one sometimes has to retain well-placed secondary shoots in order to replace a missing spur or one that was poorly placed spur and could not respond sufficiently well. In the cordon forms one sometimes has to keep one of the basal buds to prevent the fruiting area from spreading as, even when the lower part of the vine is pruned, as time goes by a small cane with a spur at the end may grow out and upwards and move the fruiting area to an incorrect position.

2.2.3.2. ORIENTATION OF THE SHOOTS

In the DDR, with the methods that are currently used and recommended for mechanized vineyards, the shoots are directed upwards to form a canopy that, after trimming on the top and sides, measures about 1.2-1.3m tall and 0.4-0.5m wide and is ideally 2-3 layers thick. The canopy must be as even as possible so that one can more easily and fully perform the viticultural operations, obtain a satisfactory yield and a uniform and good quality ripening of the grapes. The shoots must therefore be trained as they develop until the canopy reaches its final shape. The first step consists in guiding and attaching the shoots to the single or double wire immediately above the carrier wire. This operation must be well-timed and carried out as quickly as possible as growth at this time is very rapid and it coincides with other essential operations such as fungal spray treatments that must be done simultaneously. Until this first attaching

operation is not concluded on a section of vineyard, tractors and other machines will find it extremely difficult to circulate between rows and carry out treatments, which increases the risk of mildew or oedium infections.
On the other hand, the later this is done, the more it will cost. To make this operation faster and more efficient, the trellis system must contain a pair of movable wires for attaching the shoots. Before the operation, these wires are kept low down so that when they are raised they take the shoots upwards with them. The shoots are fixed between the two wires with the help of plastic or metal staples attached to the double wire, therefore reducing their pull and strain sideways. Later on the shoots are gradually guided to single or double wires higher up. Solutions for the correct orientation of the shoots depend essentially on the structure of the trellis system and the solutions that are found for the mobility of the wires.

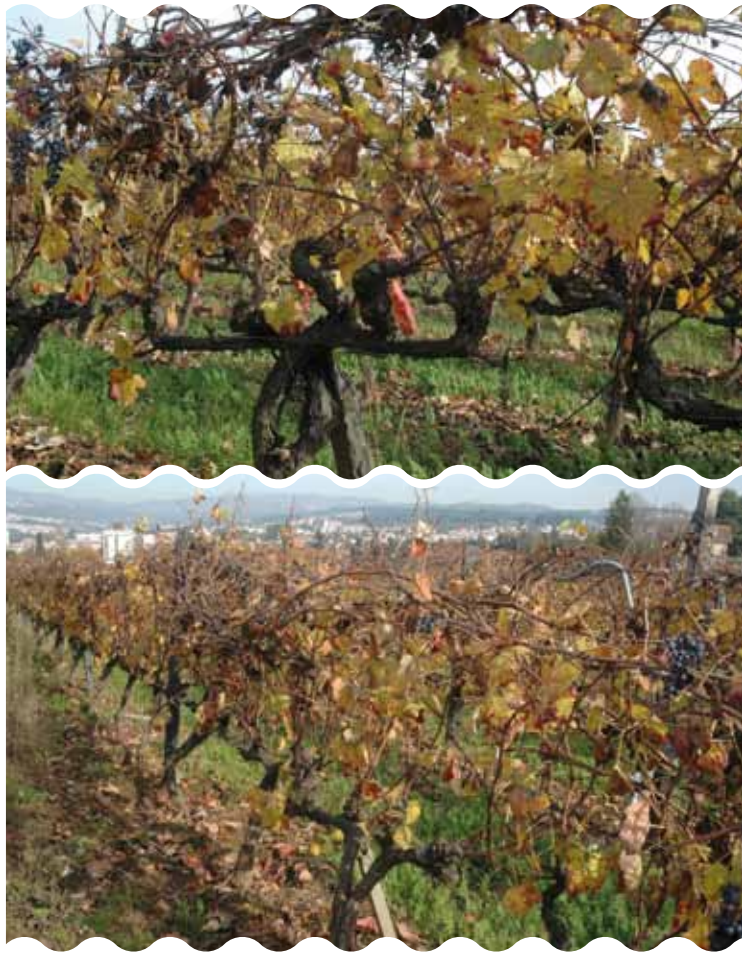
2.2.3.3. SHOOT TRIMMING

In traditional vineyards the sides of vines were not trimmed back to provide room for men and animals to circulate as they worked amongst the plants; obstructive shoots and branches were usually just rolled out of the way, around the top wire of the trellis. Today, such a practice is no longer called for as the rolled material gets in the way of the pre-pruning machines and of the removal of the cuttings (Figure 30). Shoot trimming consists of cutting the tips of the shoots so as to shape the canopy according to the desired height and width, thus ensuring that it is well-balanced and offers the best conditions for pest and pathogen control and for the grapes to ripen. At the same time, by trimming back the sides of the vines men and machines and even animals are better able circulate along the rows, especially when backpack sprayers are used for disease control.

Under DDR conditions, shoot trimming should be done between the onset of flowering and up to two weeks after budding, or even earlier when shoots have grown so much that machines are finding it difficult to move down the rows. Furthermore, early shoot trimming during this period, to eliminate the apex of the leaves, encourages the growth of offshoots at the base of the spurs and whose leaves will protect the bunches of grapes from high temperatures and strong sunlight during the ripening period, thus preventing scorching or shrinkage of the grapes. These leaves also provide an important source of carbohydrates for ripening, as they represent a build-up of reserves in the living plant that compensates for decreased photosynthesis by the main leaves. In situations where the vines are growing relatively quickly, shoot trimming may have to be repeated once or more often to control their growth and retain the shape of the canopy.

2.2.3.4. LEAF REMOVAL

Leaf removal of the bottom leaves on the spurs in the fruiting area is done in order to ensure a better early control of diseases of the vine and later, botrytis and acetic rot in the bunches; it also makes manual harvesting easier. Because of the nature of the climate in the DDR, leaf removal is only called for in relatively chance situations as the extreme heat and strong sunshine that affect most of the region during the Summer cause the leaves to drop off naturally. Nevertheless, at some of the highest altitudes or in the Lower Corgo sub-region where the influence of the Atlantic winds is felt more strongly in terms of rainfall and the relative humidity of the air, leaf removal is recommended in the case of varietals that are more sensitive to oedium as this can create a better circulation of air around the bunches and facilitate disease control. In this case, leaf removal is done early on, from the beginning of June, as the grapes begin to form.



FIGURES 30A AND 30B - Shoots, rolled out of the way around the top wire, are difficult to remove after pruning. In the upper photo the spurs position is excessively long which reduces de leaf surface.

FIGURE 31 - A shoot trimming machine.

- However, as the very hot summer sun can scorch the grapes, care must be taken only to remove leaves from the side of the row of vines that is shaded during the afternoon when the temperature is highest and radiation is strongest.

Leaf removal to control rot, although relatively less frequent than mildew and oedium and more localized and more or less specifically sensitive according to the varietals, may be justified after the onset of the ripening of the grapes, particularly when they are located in the midst of thick, poorly aired dense canopies. Here again, one must be aware that there is a risk that the grapes may be scorched unless one only strips the side of the row that is most protected from the afternoon sun. One must also not forget that the later removal is done and the more the developing bunches of grapes are exposed, the more sensitive the grapes become to this phenomenon.

Leaf removal next to the bunches just before the harvest can also be useful as it will help with the manual picking of the grapes. Where mechanical harvesters are used, although these are infrequently employed in the DDR, leaf removal before harvesting may also be justified in the sense that this will reduce the number of leaves that are accidentally picked by the machine, even when it is fitted with a vibratory device for this purpose. Leaf removal is generally done by hand, which adds greatly to the cost of an operation that can be done by removal machines of which there are several models, either attached to a tractor or motorized portable devices carried on a worker's back.

2.2.3.5. CROP THINNING

Crop thinning is done at the onset of the ripening of the grapes with a view to, by reducing the productivity of the vine whilst retaining the total surface of the foliage, improve the ripening of the remaining bunches and, consequently, the quality of the wine. It is, however, an operation that is only carried out in very specific situations in any domestic or foreign vineyard and even less frequently in the Douro where productivity itself is usually very limited. Crop thinning is only practised for small lots of highest quality wines and in very special cases. It is also a quite expensive operation that is only justified when there is a significant added value in terms of the price paid for the wine. The end does not always justify the means.

Crop thinning generally involves leaving a single bunch per spur, preferably a small one to reduce the amount of wine even further, as the vine will always end up compensating for this with some increase in the volume of the remaining bunches. Because of this, before proceeding with any crop thinning one must first estimate the amount of wine that would be made without this operation and then calculate the percentage of that wine that shall be reduced.

2.3. INTEGRATED PEST AND PATHOGEN CONTROL

Integrated Pest and Pathogen Control (IP), a practice that is included in the Integrated Production as a means for protecting crops from disease, is directed at contributing to balanced agrarian ecosystems by naturally controlling harmful organisms and by using other appropriate measures to prevent these from attacking at levels that would cause significant economic harm. This practice is based on the following: Assessment of the risk, Economic level of attack (ELA), Choice of control measures (Alves F., 2003).

The Integrated Pest and Pathogen Control concept comes under the scope of sustainable agriculture, that is, of Integrated

Production, as defined by the IOBC-WPRS and regulated in Portugal by Decree-Law 180 of 26 July 2995 and Decree 65 of 28 January 1997. The Portugal guidelines also address other requirements of an economic, ecologic and toxicological nature, protecting ancillary controls and setting limits for the chemical control of pests and pathogens by encouraging the use of pesticides with the fewest side effects.

There are both direct and indirect integrated control methods. The first of these are influenced by the assessment of the risk, of the cost of the attack or by the models; whenever possible, biological and biotechnical methods are recommended rather than chemical controls that should be limited to the absolute minimum indispensable and to selective pesticides. As to the indirect measures, these include the optimal use of natural resources namely planting varietals that are resistant to or that tolerate certain pests and pathogens, optimal training methods that favour the circulation of air and light in the canopy and maintaining areas of ecological compensation to promote biodiversity, viticultural practices that have no negative impact on the agrarian ecosystem such as not resorting to excessive amounts of fertilizers, particularly those containing nitrogen that are more susceptible to pests and pathogens, planting grass to encourage biodiversity, safeguarding and increasing ancillary controls for example by introducing mites to the vineyard and promoting earth resistance to make it easier to fight diseases that are transmitted by pathogens in the soil (Boller et al., 1993, cit. by Alves, 2003).

The practice of Integrated Pest and Pathogen Control in Viticulture requires as specific a knowledge as possible of the prime enemies, without neglecting the secondary enemies as these are sometimes equally important. "In order to comprehend the risk of an attack by these enemies one has to use simple, practical and precise technique to estimate the risk as this, associated to the understanding of the economic or other levels at risk from an attack, enables one to determine when one has reached a situation in which one must take the decision to act. It is then that one must carefully select the protective measures by making a global assessment of the risk, having recourse to chemical warfare only as a last resort and then preferably using pesticides that are the least toxic to Man, to the ancillaries and to the environment" (Alves, 2003). If these practices are to be correctly implemented, the technical managers and the winegrowers involved must be properly trained. If they are not, there may be cases where there is a tendency for inflexible pre-conceived treatment schedules to be applied or these may be incorrectly applied, with the consequent disastrous results.

The concept of what is a "prime" and "secondary" enemy of the vine may vary from region to region according to their incidence. The following are considered prime enemies in the DDR: mildew (Plasmophora vitícola), oedium (Uncinula necator) and grey rot (Botrytis cinerea). The most common secondary enemies, excoriose (Macrophoma flaccida), a eutypa (Eutypa lata), and esca (Phaeoacremonium spp), amongst other fungi that are precursors of degenerative diseases of the wood, are frequently found in rooted grafts. As regards prime pests, we have the grape moth in the Lower and Upper Corgo and the grapevine leafhopper in the Upper Douro; secondary pests are Othyorinchus spp., the green caterpillar, scale insects, the grape flea beetle and, recently, Scaphoideus titanus, a cicadellidae and vector of the grapevine phytoplasma disease.

With a view to assisting in the choice of pesticides to control pests and pathogens in the vine, the Ministry of Agriculture publishes an annual, list of pesticides approved for Integrated Pest Control, with details of their active substances and respective doses per hl. The 2011 list is attached to this Manual.

3.

LEGISLATION AND CROSS-COMPLIANCE REGULATIONS FOR VITICULTURE IN THE DDR

Cross-compliance regulations represent a set of basic conditions that apply to all farmers who benefit from rural development programs, as part of certain measures for the sustainable management of rural areas, namely and including the Support Program for the Reconversion and Restructuring of Vineyards or subsidies for digging up vines. Failure to comply with these regulations may affect the payment of subsidies that may be reduced or totally withdrawn. The regulations are expressed as a set of standards or guidelines, as follows: Good Agricultural and Environmental Practices; Legal Management Requirements; PIOT-ADV; National Ecological Network (REN).

Added to these regulations are the rules for choosing the location of the vineyard that are set forth under Decree-Law 173/2009 of 3 August 2009 and Decree 413/2001 of 18 April 2001, both mentioned in Item 2.1.1 of this Manual.

3.1. GOOD AGRICULTURAL AND ENVIRONMENTAL PRACTICES (GAPS)

GAPs are part of a set of binding standards and regulations under Council Regulation (EC) 73/2009 of 19 January 2009 for farmers and beneficiaries of support schemes under the common agricultural policy. They are included with the regulations for combatting erosion of the soil and organic matter, preserving the characteristics of the landscape and the use of water for irrigation.

3.2. LEGAL MANAGEMENT REQUIREMENTS (LMRS)

LMRs refer to compliance with EC regulations that have since been transposed to Portugal jurisprudence, in the fields of the environment, public and animal health and welfare. The indicators that must be applied to agriculture and that are related it under Rede Natura 2000 network, are given after the following list of actions and activities for which an opinion from the ICNB is required, according to Decree-Law 140/99, as amended by Decree-Law 49/2005 of 24 February 2005.

3.3. PIOT-ADV

The regulatory guidelines for PIOT-ADV, as defined by Council of Ministers Resolution 150/2003 of 22 September 2003 and Joint Decree 473/2004 of 30 June 2004, setting the compulsory conditions for permission to act within the classified area, namely regarding the planting or replanting of vines or other permanent crops such as olive and almond trees, state as follows:

- May not obstruct or destroy any natural drainage or other drains previously correctly built;

- May not cause any changes to riparian morphology (banks of streams and their vegetation).

The planting or replanting of vines (or other permanent crops) is subject to the prior opinion of the DRAPN and the Coordinating Committee for the Development of the North of Portugal (CCDR-N) and must comply with the following stipulations:

- Planting of vines on slopes greater than 50% is prohibited unless the area in which they are to be planted is destined for reconversion because it has previously been planted with vines or other crops such as olive or almond trees, or it corresponds to a mortório (pre-phylloxera vine-covered terraces, since abandoned). In this case, the vineyard must be laid out in the form of micro-patamares;

- Vertical plantings are only permitted on slopes below 40%, the maximum incline on which standard traction machines can operate. However, in the case of soil that is more susceptible to erosion, particularly in the Lower Corgo sub-region or in the Extremadouro (boroughs of Mesão Frio, Régua, Lamego and Santa Marta de Penaguião), the maximum slope is set as 30%;

- In the case of slopes between 40 and 50% or between 30 and 50%, in the above case, the vineyard may be created in the form of narrow (2.5 to 2.8m-wide) patamares with one row of vines or as micro-patamares (1.5 to 1.6m wide);

- A map of the drainage system designed for the chosen vineyard method must be submitted whenever more than 5ha of land are to be planted with vines or when the slope is greater than 20%;

- In the case of a vineyard that is laid out continuously and in an identical manner over more than 10ha, trees and other types of natural borders must be planted on either side of the access roads to the land. A management plan for the entire property must be submitted for identical types of vineyards but covering more than 15ha, where there are traditional drainage systems and other assets;

- New planting on walled land already occupied with vines, olive or almond trees, or a mortório, must be on narrow patamares or micro-patamares but always preserving the stone walls, except in those cases where the DRAPN or the CCDR-N approve their removal;

- It is expressly forbidden to destroy any type of traditional assets (dry stone walls, cobblestone paths, typical buildings, mortorios, primeval woods), except when specifically and duly justified and approved by the DRAPN.

Furthermore, as Item 72 of Decree-Law 309/2099 and Notice 15170/2010, has classified the area surrounding the Alto Douro World Heritage Property as a Specially Protected Area, the entire Douro Demarcated Region must comply with the PIOT-ADV regulations.

3.4. NATIONAL ECOLOGICAL RESERVE (REN)

The purpose of the REN, created by Decree-Law 321/83 of 5 July 1983, as later amended by Decree-Law 166/2008 of 22 August 2008 and Decree 1356/2008 of 28 December 2008, is to protect the natural resources, especially the water and soil, safeguard procedures considered indispensable for the proper management of the territory and promote the protection of nature and biodiversity. The majority of the DDR belongs to the REN, which is why when one is considering any intervention you are first required to inform the CCDR-N that may, after receiving the opinion of the DRAPN, authorize the intervention, with or without conditions, or even prohibit it.

Activities that come under the REN regulations are as follows:

- building barns or sheds for crops;

- changing the topography and building walls and patamares to adapt the land for farming;

- planting vines or other crops;

- opening roads for farming and forestry purposes;

- pest control;

- weeds and wild plant control required by law as conditions for implementing projects.

4.

PRODI (PORTUGUESE INTEGRATED VINEYARD PRODUCTIVITY RULES AND REGULATIONS), FOLLOWING IOBC-WPRS (1999) GUIDELINES

(Adapted from Alves F., 2003)

QUALIFICATION AND TRAINING OF THE WINE GROWER

COMPULSORY

During the year of accession to the program, attend and pass a training course lasting at least 70 hours.

RECOMMENDED

Participation in annual updating courses, in workshops on the annual evolution and pests in the region and in meetings in the application of techniques for assessing risks is demonstrated.

PRESERVATION OF THE WINEMAKING ENVIRONMENT

COMPULSORY

Collect waste plastic, tyres and oil and respect the applicable guidelines for the management of the area designated as nature reserves.

RECOMMENDED

Employ methods that will protect the soil such as sowing grass permanently or temporarily in areas where there is a greater risk of erosion.

Create areas of ecological compensation next to vineyards that must not be treated either with pesticides or fertilizers. These areas should correspond to about 5% of the land under vines and are even more important in the case of vineyards covering more than 5ha.

CREATING AND PLANTING A VINEYARD

CHOOSING THE LOCATION AND PREPARING THE SOIL

COMPULSORY

Analyse soil previously planted with vines for the presence of nematodes and pathogenic fungi. If the analyses are positive, wait 4 to 7 years before any new planting.

Integrated Production vineyards in the DDR should be planted in originally shistous soil, without patches of granitic soil, with a recognized ability for producing quality wines. They must be planted in continuous rows, low on the ground, cane or cane and spur pruned, and wire trained.

A study of the draining system suited to the layout is required for vineyards planted on more than 5ha or on slopes greater than 50%. Tree or plant borders must be planted on either side of access roads to vineyards planted continuously over more than 10ha. A management plan for the entire property is required for vineyards planted continuously over more than 15ha and containing traditional drainage systems or other assets.

Planting density must never be less than 4,000 vines per hectare, with a 20% tolerance, except vineyards on patamares and terraces where the minimum density may be 3,000 vines per hectare, with a 20% tolerance; this also applies to vineyards planted before 11 August 1998 and still being worked.
Vertical vineyards may only be planted on slopes or land with a less than 40% incline, except in the Extremadouro (Lower Corgo) landscape reserve where the maximum slope is 30%.

FORBIDDEN

The chemical disinfection of the soil is prohibited, as is any obstruction to natural or previously correctly placed drainage lines.

The planting of vines on slopes greater than 50% is prohibited, except when the land in question, included in nature or agricultural reserves, is planted with vines or olive trees, walled in or is a mortorio, in which case a micro-patamar model that preserves the supporting walls is compulsory, or when the land was used before as an olive or almond grove or for other crops, in which case the model may be either that of narrow patamares or micro-patamares. Where the slope is between 40 and 50%, planting may be on narrow patamares or on micro-patamares, except for the aforementioned situations where the incline exceeds 50%.

RECOMMENDED

Vineyards should preferably be located in sheltered areas with a good exposure; more aggressive exposures should be reserved for varietals whose foliage and grapes are more resistant to scorching.

The profile of the soil must be examined before planting a vineyard in order to determine its viticultural suitability, how best to work the land and mark the drains, fertilize the soil and choose the most appropriate rootstock.

Vines should not be planted in areas where efficient drainage is not feasible.

When a new vineyard is being planted on land that was previously occupied by vines or other dendritic crops, the land must be cleared of all old roots and wild plants and grasses that might be difficult to remove permanently.

SPACING OF VINES AND ROWS

COMPULSORY

According to PIOT-ADV and other regulations, there are no restrictions regarding the spacing of vines or rows of vines, except regarding the minimum planting densities that must be respected.

RECOMMENDED

The spacing should be the most appropriate for each specific situation, based on the fertility of the soil, the rainfall and the strength provided by the rootstock and that which is native to the varietal. Another important factor is the possibility of simplifying the mechanization of the various viticultural operations according to each training system and the requirements of steep slope viticulture.

PLANT MATERIAL

CHOICE OF THE ROOTSTOCK

COMPULSORY

Dormant canes from which buds are taken for grafting must be provided with a health passport from an officially certified nursery. Rootstock must belong to a certified category (blue label) when used for direct planting or as part of the rooted rootstock. In this case, considering that the varietal scion is not always certified, an inferior category, standard classification is permitted. Authorization for varietals authorized for DOC Porto and DOC Douro wines is defined by Decree 413/2001 of 18 April 2001.

RECOMMENDED

A profound knowledge of the behaviour of every rootstock, every varietal, every combination of rootstock and voarietal, is strongly recommended, particularly regarding vigor, productivity, ripening, sensitivity or resistence to hydric stress, onset of the growing cycle and different sensitivies to the lack of certain nutrients. It is therefore important that each varietal is planted according to the exposure, altitude and characteristics of the soil and that varietal's ability to adapt itself. It is also recommended that sections of vineyards should be planted in groups of single varieties of vine and when they cover less than 1ha of land, with one varietal only.

Preference must always be given to scions of varietals that were obtained by genetic and sanitary selection; several (minimum 6 to 8 and maximum 10 to 12) clones of a same varietal, either planted separately or mixed together, are recommended when creating a new vineyard.

SOIL MANAGEMENT AND FERTILIZATION

MAINTENANCE OF THE SOIL

FORBIDDEN

Herbicides are absolutely forbidden in Integrated Production vineyards, except along the rows. Exception is made of special circumstances where wild plants and weeds are proving difficult to control, and in old vineyards where the vines were not planted in rows (rarely the case in the DDR).

RECOMMENDED

The soil between the rows of vines must be protected from erosion during the rainy seas (mid-October to the middle of Spring) with of grass, either purposely or spontaneously grown, as an alternative to tilling. In certain situations, this makes it easier for tractors to circulate when they are spraying the plants.

FERTILIZATION AND INSTALLATION

COMPULSORY

The fertility of the soil and its chemical and physical characteristics must be determined by analyses before planting a vineyard. Application of organic material is compulsory whenever pH is less than 6.0 (H20) and free copper is greater than 20ppm. Guidelines for collecting soil samples and the required laboratory analyses are described in 2.1.7.

FORBIDDEN

No more than 10 to 15Kg of nitrogen (N) can be applied per hectare. The use of uncertified solid urban waste, that is well-matured, hygienic and with low heavy metal contents products, and other untreated sewage materials, is regulated by Decree-Law 446/91 and Decree 176/96.

RECOMMENDED

The amount of calcium to be applied will depend on the pH of the soil and its buffering power. The application of organic correctives is recommended whenever the organic material content is below 1%. Applications of well-cured bovine manure, or equivalent organic fertilizer, greater than 30t per hectare are not recommded. Mineral nitrogen should not be used in the first fertilization. On this occasion, apply amounts of phosphorus, potassium and magnesium according to their free content in the soil and the pH, as this will affect the way in which they are assimilated.

FERTILIZATION - PRODUCTION

COMPULSORY

Soils must be analysed every four years and leaves every two years (annually is recommended). Apply fertilizers to the soil. Exceptions are those cases in which the roots are unable to absorb nutrients because of poor soil or climatic conditions, when confirmed by the integrated production technician. Regar Efectuar análises de solo de quatro em quatro anos e foliares de dois em dois (recomendável anualmente). Aplicar os fertilizantes ao solo. Consideram-se excepções os casos em que, devido a insuficiente absorção de nutrientes pelo sistema radicular, originada por condições desfavoráveis de solo ou clima, após justificação do técnico de produção integrada. Guidelines for collecting soil samples and the required laboratory analyses are described in 2.1.7.

FORBIDDEN

Nitrogen may not be applied before the normal budding season. The application of total annual doses greater than 5Kg of N per ton of grapes is also forbidden.

RECOMMENDED

Recommended fertilization shall be done on the basis of the results of the analyses of the leaves and the soil and, in the case of vineyards that are irrigated, on the results of the analysis of the water, especially as regards its nitrogen content. Phosphorus, potassium and magnesium in average or finely textured soils should be applied in the Fall or Winter and be dug in deeply so that they are easily absorbed by the vines. Boron may only be applied onto the leaves up to mid-March or before flowering. If any correction is required, this should be done at the end of Winter. A maximum 10t of boron per hectare per year is the recommended maximum dose.

IRRIGATION OF THE VINE

COMPULSORY

All water used for irrigation must be analysed except in accordance with the stipulations of Decree-Law 236/98 of 1 August 1998.

FORBIDDEN

A vineyard may only be irrigated in exceptional circumstances and only in cases of extreme drought, recognized by the IVDP, that may adversely affect the normal development of the vines.

RECOMMENDED

Drip irrigation is the most appropriate for vineyards. Drip systems under pressure are recommended to ensure the uniform distribution of water along the row, especially in vertical plantings. Calculation of the irrigation must consider the available water in the soil, the amount of evapotranspiration and the amount of water in the plant, as determined by the hydric potential of the leaves.

PRUNING AND TRAINING

COMPULSORY

The vines must be planted in continuous rows, low on the ground, cane pruned and cane and spur, cordon or wire trained, with a single fruiting area and cultivated with the means and methods that are appropriate to the location as a way of getting the grapes to do their utmost to produce quality wine.

RECOMMENDED

The structure of the vineyard and the training of the grapes must be directed at creating a canopy with an appropriate amount of exposed shoots, vegetation density and rigor, compatible with the volume of the production, its potential for quality and a microclimate that is favourable to pest and pathogen disease and control. In vineyards where diseases of the wood have been detected, prunings must be removed and burnt. Where this is not the case, the prunings should be crushed and spread over the earth.

INTEGRATED PEST AND PATHOGEN CONTROL

COMPULSORY

Chemical methods of pest and pathogen control may only be used when the economic level of attack (ELA) has been reached or, when this is unknown, it is justified by the technician because of the scope and the magnitude of the attack. (See attached list of approved products and conditions for their usage). Carry out weekly checkups to determine the evolution of the pests and pathogens during the period of highest risk from the agents. Record all actions in a field notebook.

FORBIDDEN

The use of pesticides and similar products that have not been approved for integrated disease control is strictly forbidden.

RECOMMENDED

Whenever possible, use biologic, biotechnical, physical, genetic and agricultural methods to control diseases. Carry out treatments based on the forecasts from the regional advisory services. Keep small untreated areas so as to preserve their biodiversity. Introduce and increase the use of ancillary organisms and follow-up their progress. Keep in mind notices from the Douro Warning Station. Use models for estimating the risk of pests and diseases of the vine. If possible, maintain records of the weather.

FIELD NOTEBOOK

COMPULSORY

The field notebook is considered the basic document for Integrated Production as it contains the records of the vineyards, the viticultural operations and incidences of pests or diseases throughout the year, as well of all chemical products, pesticides and fertilizers applied. According to Decree-law 180/95 of 26 July 1995 and complementary legislation, winemakers must also attach not just the labels for the chemical products, pesticides and fertilizers, but also copies of the results of the laboratory analyses that were carried out.

EFFECTIVE AND SAFE SPRAYING

RECOMMENDED

In order for spraying programs to be successful, as it is important that one merges the chemical and the mechanical methods, we recommend that the spraying equipment is examined to confirm that it is working properly and not applying excessive or insufficient doses of the treatment products. Do not spray on windy or very hot days, especially when handling highly toxic substances, wear appropriate clothing and protective equipment, avoid any contact with the product, do not spray neighbouring crops, do not contaminate the environment, spray evenly using the correct amount of product, do not unblock filters and tips with one's mouth, do not eat, drink or smoke when spraying, and carefully wash everything after finishing.

HANDLING OF PHYTOSANITARY PRODUCT

RECOMMENDED

Observation of the following precautions and principles are strongly recommended for Integrated Production: the label of a chemical product or pesticide must indicate the interval of safety, the maximum amount of residue and the toxicological classification; products must be stored according to GCPF industry guidelines; as these products are potentially toxic they must not be stored in the same warehouse as food products, animal feed and other products such as clothing, tobacco, cosmetics, etc.; the pesticides themselves must be stored in groups according to their class of toxicity; never re-use empty containers; always use protective equipment (goggles, gloves, masks and overalls).

ANNEXES

For additional information and annual updatings, please consult the lists published by the association for the development of douro viticulture - ADVID (www.advid.pt) and by the regional directorate for agriculture and fisheries for the north of portugal - DRAPN (www.drapn.min-agricultura.pt).

LIST OF HERBICIDES

LIST OF PESTICIDES FOR P.I.

Anti-mildew; Anti-oedium; Anti-botrytis; Insecticides

IP-APPROVED HERBICIDES FOR USE IN VINEYARDS (DGADR - DSPFSV, 2012)

ACTIVE SUBSTANCE	FORMULATION	CC PRODUCT	DOSE /ha	Infestation	AGE OF VINE
RESIDUAL					
Flazasulfuron	WG	50g/l	0.2kg	A (D + M)	3 years
Isoxaben	SC	125g/l	6 - 8 liters	R (D)	1 year
Oxyfluorfen	EC	240g/l	1.5 - 4 liters	A (D + M)	3 years
pendimethalin	EC	330g/l	4 - 6 liters	A (D + M)	1 year
Terbuthylazin	SC	500g/l	3 - 4 liters	A (D + M)	4 years
FOLIAR					
Cycloxydim	EC	200g/l	2 l (A) - 4 l (V)	A + P (M)	1 year
Fluazifop - P - butyl	EC	125g/l	1 l (A) - 3 l (V)	A + P (M)	1 year
Quilazofop -P - ethyl	EC	50g/l	1 l (A) - 3 l (V)	A + P (M)	1 year
Glyphosate (isopropylammonium salt)	SL	356g/l	2 l (A); 4 - 10 l (V)	A + P (D + M)	3 years
Glyphosate (potassium salt)	SL	360g/l	1.5 l (A); 6 - 7 l (V)	A + P (D + M)	3 years
Glyphosate (ammonium salt)	SL	360g/l	1.5 l (A); 6 - 7 l (V)	A + P (D + M)	3 years
Ammonium glyphosate	SL	200g/l	4 l (A); 6 - 10 l (V)	A + P (D + M)	1 tear
MIXED (RESIDUAL AND CONTACT)					
Amitrole	F(S) + R(C)			A (D + M)	
Amitrole + ammonium thiocyanate + terbuthylazine	SC	191 + 100 + 180g/l	5 - 7.5 l (A)	A (D + M)	4 years
Diflufenican + glyphosate	SC	40 + 160g/l	6 - 8 l/ha (A)	A (D + M)	4 years
Diflufenican + glyphosate + oxyfluorfen	SC	50 + 200 + 30g/l	5 l/ha	A (D + M)	4 years
Glyphosate + oxyfluorfen	SC	200 + 30g/l	4 - 6 l/ha (A)	A (D + M)	3 years
Glyphosate + terbuthylazine	SC	180 + 340g/l	5 - 7 l/ha	A (D + M)	4 years

A - Annual; P - Perrenial; Dicotyledones; Monocotyledones
SC - Concentrated suspension; F(S) -Foliar uptake (systemic); RC - Residual contact; EC - Emulsion concentrate; SL - Concentrated solution

IP-APPROVED INSECTICIDES

GRAPE MOTH

TYPE OF CONTROL	PRODUCT	FAMILY	S.I. (DAYS)	PERSISTENCE	DOSE/HL	WHEN TO APPLY
BIOLOGICAL	Bacillus thurigiensis	Bacteria	1	10 - 12 days	50g	On eggs before hatching
	Spinosad	Metabolite	14	7 - 14 days	10 - 12ml	On eggs before hatching
SEXUAL CONFUSION	Dodecadienil acetato	Pheromones	0		500 diffusors/ha	March-April
BIOTECHNICAL	Fenoxycarb	Carbamate	14	14 - 21 days	30 - 40g	During the laying of the eggs
	Flufenoxuron	Acyl urea	56	21 - 28 days	50ml	During the laying of the eggs
	Fenoxicarb + lufenuron	Carbamate+acyl urea	14	21 days	100ml	During the laying of the eggs
	Tebufenozide	Hydrazine	14	14 - 21 days	60ml	During the laying of the eggs
	Methoxyfenozide	Hydrazine	14	14 - 21 days	30 - 40 ml	During the laying of the eggs
CHEMICAL	Chlorantraniliprole		28	10 - 14 days	15 - 17.5ml	Before hatching and piercing of the grapes
	Indoxacarb	Carbamate	10	14 - 21 days	12.5g	At the height of the infestation (NEA)

GREEN LEAF-HOPPER

TYPE OF CONTROL	PRODUCT	ACTION	EFFECT	PERSISTENCE	S.I.
BIOTECHNICAL	Flufenoxuron	Ingestion + contact	Ovicide	21 - 28 days	8 weeks
CHEMICAL	Fenpyroximate	Contact	Larvicide	15 - 30 days	2 weeks
	Indoxacarb	Ingestion	Larvicide	10 - 14 days	10 days
	Imidacloprid	Ingestion + contact	Larvicide	14 - 21 days	2 weeks
	Thiamethoxam	Ingestion + contact	Larvicide	14 - 21 days	3 weeks

IP-APPROVED ANTI-OEDIUM FUNGICIDES FOR USE IN VINEYARDS

FAMILY	ACTIVE SUBSTANCE	S.I.	DOSE	OBSERVATIONS	ACTION
CONTACT	Powdered sulphur	0	10 - 50kg/ha	Anti-excoriose and mites	P - C
	Wettable sulphur	0	400 - 800g/hl		P - C
	Meptyldinocap	0	40 - 60ml/hl		P - C
IBE	Spiroxamine	4 weeks		3 treatments maximum	P - C
	Fenbuconazole	4 weeks	80ml/hl	3 treatments maximum	P - C
	Myclobutanil + quinoxyfen	3 weeks	16 - 24ml/hl	3 treatments maximum	P - C
	Penconazole	1 week	35ml/hl	3 treatments maximum	P - C
	Tebuconazole	1 week	40ml/hl	3 treatments maximum	P - C
	Tebuconazole + trifloxystrobin	5 weeks		3 treatments maximum	P - C
	Tetraconazole	2 weeks	30ml/hl	3 treatments maximum	P - C
BENZOPHENONES	Metrafenone	4 weeks			P - C - E
CARBOXAMIDES	Boscalid + kresoxim-methyl	3 weeks			P
STROBILURINS	Azoxystrobin	3 weeks	75 - 100ml/hl	Mildew & oedium - 2nd action	P - C
	Azoxystrobin + folpet	6 weeks	150ml/hl	Mildew & oedium - 2nd action	P - C
	Trifloxystrobin	5 weeks	15g/hl	Mildew & oedium - 2nd action	P - C
	Kresoxim-methyl	4 weeks	25g/hl	Mildew & oedium - 2nd action	P - C
	Pyraclostrobin	8 weeks	125ml/hl	Mildew & oedium - 2nd action	P - C
	Pyraclostrobin + folpet	8 weeks	125ml/hl	Mildew & oedium - 2nd action	P - C
QUINOLINES	Sulphur + quinoxyfen	3 weeks	150ml/hl	4 treatments maximum	P - C
	Quinoxyfen	3 weeks	30ml/hl	4 treatments maximum	P
QUINAZOLINES	Proquinazid	3 weeks			P
MIXED	Cymoxanil + folpet + tebuconazole	6 weeks	200g/hl	Anti-mildew & anti-oedium	P - C
	Cymoxanil + propineb + tebuconazole	6 weeks	200g/hl	Anti-mildew & anti-oedium	P - C

P - Preventive; C - Contact; E - Anti-sporulating
N.B. - In IP, never apply more than 12kg/ha of wettable forms and up to 25-30kg/ha of powdered forms.

IP-APPROVED FUNGICIDES FOR TREATING GREY ROT

ACTIVE INGREDIENT	SAFETY INTERVAL	ACTION	PERSISTENCE	DOSE/HL
Boscalid	4 weeks	P	12 - 14 days	100 - 120g
Cypronidil	2 weeks	P - C - E	10 - 12 days	75g
Cipronidil + fludioxonil	2 weeks	P - C - E	10 - 12 days	80 - 100g
Fenhaximid	3 weeks	P	10 - 12 days	150g
Iprodione	3 weeks	P - C	12 - 14 days	150g
Mepanipyrim	3 weeks	P		100g
Pyrimethanil	3 weeks	P	10 - 12 days	250ml
Thiophanate-methyl	5 weeks	P - C		200g

P - Preventive; C - Curative; E - Systemic

IP-APPROVED ANTI-MILDEW FUNGICIDES

CONTACT

ACTIVE INGREDIENTS	DOSES/hl	S.I.	COMMENTS
Copper (hydroxide)	200 - 300g	1 week	Phytoxic when cold and damp
Copper (oxychloride)	300 - 600g	1 week	
Copper (cuprous oxide)	270g	1 week	
Copper (sulphate)	1 - 2kg	1 week	Phytoxic when cold and damp
Copper (sulphate + calcium + mancozeb)	300g	8 weeks	
Folpet	200 - 300g	6 weeks	Also effective against botrytis and excoriose
Mancozeb	270g	8 weeks	Also effective against excoriose
Metiram	200g	8 weeks	Also effective against botrytis
Propineb	250g	8 weeks	

PENETRATING + CONTACT

ACTIVE INGREDIENTS	DOSES/hl	S.I.	COMMENTS
Azoxystrobin	100ml	3 weeks	Mildew + oedium (block of 3 treatments)
Azoxystrobin + folpet	150ml	3 weeks	Mildew + oedium (block of 3 treatments)
Bentiavalicarb + mancozeb	180 - 200g	8 weeks	
Cyazofamid	400ml	3 weeks	
Cymoxanil + copper oxychloride	300g	3 weeks	
Cymoxanil + copper sulphate and calcium	400g	3 weeks	
Cymoxanil + copper sulphate + mancozeb	300g	8 weeks	
Cymoxanil + copper oxychloride + propineb	250g	9 weeks	
Cymoxanil + fomoxadon	40g	3 weeks	
Cymoxanil + fomoxadon + folpet	150g	8 weeks	
Cymoxanil + folpet	200g	6 weeks	Effective against botrytis, mildew and excoriose
Cymoxanil + folpet + mancozeb	400g	8 weeks	
Cymoxanil + folpet + mancozeb + tebuconazol	250g	6 weeks	
Cymoxanil + mancozeb	300g	8 weeks	
Cymoxanil + metiram	200g	1 week	Effective against botrytis
Cymoxanil + propineb	250-300g	8 weeks	
Cymoxanil + propineb + tebuconazol	250g	8 weeks	Mildew + oedium action
Copper oxychloride + iprovalicarb	150g	4 weeks	
Dimethomorph + folpet	135 - 160g	8 weeks	
Dimethomorph + mancozeb	200 - 240g	8 weeks	Anti-sporulating effect
Dimethomorph + copper oxychloride	250 - 300g	3 weeks	Anti-sporulating effect
Folpet + iprovalicarb	130g	6 weeks	Anti-sporulating effect
Folpet + mandipropamid	200 - 250g	6 weeks	
Folpet + pyraclostrobine	200ml	8 weeks	
Mancozeb + zoxamid	150 - 180g	8 weeks	
Metiram + pyraclostrobine	150g	3 weeks	
Pyraclostrobine	20 - 30g	5 weeks	

SYSTEMIC

ACTIVE INGREDIENTS	DOSES/hl	S.I.	COMMENTS
Benalaxyl + folpet	200 - 250g	8 weeks	Anti-sporulating effect
Benalaxyl + mancozeb	200 - 250g	8 weeks	Anti-sporulating effect
Benalaxyl M + folpet	200g	6 weeks	
Benalaxyl M + mancozeb	200 - 250g	8 weeks	Anti-sporulating effect
Cymoxanil + folpet + aluminium fosetyl	400g	6 weeks	Also effective against botrytis + oedium
Cymoxanil + folpet + metalaxyl	250g	6 weeks	
Copper oxychloride + metalaxyl	400g	3 weeks	
Fluopicolida + aluminium fosetyl	250g	4 weeks	
Fenamidone + aluminium fosetyl		4 weeks	
Folpet + aluminium fosetyl	300g	6 weeks	Systemic up and downstream. Anti-excoriose
Folpet + aluminium fosetyl + iprovalicarb	400g	6 weeks	Systemic up and downstream. Anti excoriose and anti-sporulating
Folpet + metalaxyl	200g	6 weeks	Anti-sporulating. Acts against excoriose + botrytis
Folpet + metalaxyl M	200g	6 weeks	
Aluminium fosetyl + mancozeb	400g	8 weeks	Systemic up and downstream. Anti excoriose
Mancozeb + metalaxyl	250g	8 weeks	
Mancozeb + metalaxyl M	250g	8 weeks	Anti-sporulating effect