NEW HOLLAND AGRICULTURE

Grapevine

PRODUCTION GUIDELINES

GRAPEVINE HANDBOOK

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HANDBOOK

Production Guidelines

GRAPEVINE	
OPERATIONS	AGRONOMICS AND TIMING
Crop rotation	Better planting a new vineyard after two or three years from the previous vineyard. During this period, cereals or forage crops can be cropped. If planting is carried out straight after the same crop, residue and roots are to be carried out of the field.
Primary tillage for planting	40 - 50 cm deep, better ripping before ploughing. Only in case of deep hard pans, tillage can reach 1 meter depth. If manure is available, to be incorporated and mixed into soil.
Secondary tillage for planting	Harrows or rototill can be applied in order to get a sufficiently fine soil structure, to allow for a good contact between soil and roots of cuttings and or rootstocks.
Planting, training systems, pruning (Northern Hemisphere)	Timely planting in October. Beginning of Spring (February- May) is a good alternative, depending on local conditions. Avoid freezing periods. Distance between rows from 1 meter (traditional but irrational and no more suggested) most commonly for vertical trellis is 2,5-3 meters: for horizontal trellis up to 4,5 meters in GDC-types training systems. Distance between plants also varies a lot, but most commonly for vertical trellis is 0,8-1,5 meter, up to 4 meters in particular conditions. Density of plants per hectare is extremely varied, from 1000 to 10000 plants per hectare: most commonly in wine producing areas is between 2000-5000 plants. Also here, density depends basically from chosen training system and desired quality of vine. Pruning both dry and green can be performed manually, mechanically or both, meaning a mechanical pre-pruning with manual finishing in some training systems.
Base fertilization and production fertilization	Soil analysis from 40 and 80 centimeters deep suggested before planting a new vineyard. Then foliar diagnostics yearly and soil analysis every 4-5 years
Soil management	Many patterns possible, but basically with turf on interrow spaces or completely tilled. Weed control mostly only along and beneath the rows.
Pest control	A crucial factor. Applications of fungicides and insecticides by spraying
Harvesting	Manual or mechanized

TOP GRAPE PRODUCING COUNTRIES BY YEARS (in metric tons)

Country	2009	2010	2011	2012	
China	8,038,703	8,651,831	9,174,280	9,600,000	F
USA	6,629,198	6,777,731	6,756,449	6,661,820	
Italy	8,242,500	7,787,800	7,115,500	5,819,010	
France	6,101,525	5,794,433	6,588,904	5,338,512	
Spain	5,535,333	6,107,617	5,809,315	5,238,300	
Turkey	2,264,720	4,255,000	4,296,351	4,275,659	
Chile	2,600,000	2,903,000	3,149,380	3,200,000	F
Argentina	2,181,567	2,616,613	2,750,000	2,800,000	F
Iran	2,305,000	2,225,000	2,240,000	2,150,000	F
South Africa	1,748,590	1,743,496	1,683,927	1,839,030	
Total	**47,649,145**	**48,864,531**	**49,566,117**	**46,924,343**	
World	**58,521,410**	**58,292,101**	**58,500,118**	**67,067,128**	

Source: UN Food & Agriculture Organization (F= FAO estimate)

Depending on the vine cultivar, training system, density of plantation and pruning scheme, harvest could yield between 5 and 20 tons of grapes per ha.

TOP PRODUCERS OF GRAPE FOR WINE MAKING

Country	Hectares
Spain	1,175,000
France	864,000
Italy	827,000
Turkey	812,000
USA	415,000
Iran	286,000
Romania	248,000
Portugal	216,000
Argentina	208,000
Chile	184,000
Australia	164,200
Armenia	149,500
Total	**5,548,700**
World	**7,586,600**

Climate

Like any crops, grape growth is limited by certain climatic conditions. Generally, in Northern hemisphere, grapevine matures from Equator to 50° Northern latitude: in Southern, from Equator to 45° Southern latitude (exceptions may exist). Grapevines need a reasonably long growing season (150–200 days free of frost) with relatively low humidity (about 600 mm per year) during the vegetative season, but sufficient soil moisture is necessary. If soils are well drained, water is not a problem; excess of water in soils (ponding) is a big problem. Of course, possibility of irrigation brings to nothing water supply problems. The temperatures from April to September are crucial for reaching good development of the vine and ripening of the fruits. When temperatures are below 10 °C, vines stops growing. The optimum temperature is between 25 and 30 °C. Temperatures higher than 38 °C will stop plants growth. The index of Winkler and Huglin is the sum of daily temperatures above 10°C during the growth season from April to October. Early cultivars reach maturity when tis index is from 1600 to 2000°C during the period between blooming and ripening. For late cultivars, the value is 3000°C.

Soils

Grapes can be produced on a number of different soils – chemical fertility is important, but not more important than soil structure and texture. In a very general way, clayish, fertile soils give robust red wines: sandy soils give aromatic white wines. Sandy or gravelly clay loams are most desirable; local soil attributes together with local climate characteristics, confer to wines different and often unique organoleptic characteristics as flavor, alcohol content, taste, acidity. Alkaline soils must be avoided, as well as very acidic ones, or they both must be amended, if economically suitable. Good drainage is crucial for quality production.
In most countries, vines are grafted on rootstocks that are carefully selected depending on resistance to Phylloxera and characteristics of the soil.

Biology and annual cycle

Vine grape's annual cycle is divided in two phases, vegetative and reproductive. Vegetative stages begins with "weeping" in early spring: sap is coming from the roots and it goes out through the pruning cuts. After that (temperature is between 4 and 13°C, depending on cultivars, with and average value of 10°C) buds swell and burst (March-April) ; following the burst of buds, at the beginning slowly sprouts (shoots) are formed: afterwards, shoots and foliage emerge quicker during the spring and the summer. An important phase is the lignification of shoots during August: shoots become "canes", thus producing dormant buds for production of new sprouts during the next season. All these processes are ruled by temperature regime and presence of hormones in the plants.

The first part of reproductive stage begins roughly at the end of May with pre blooming stage. Blooming last to mid June: during blooming, usually a certain share of flowers do not continue the process and drop. Pollination begins after blooming and ends with formation of "buckshot berries". Not each flower gives a berry: on average, the fruit set value is between 60 and 30%, depending on cultivar and climate. The berry increase their volume until veraison (August), when berries take the color which is typical for the cultivar. After veraison, ripening continues to the harvesting in Autumn. After the fall of leaves in the end of Autumn and during the winter, vine grapes are dormant and more resistant to frost.

VINE GRAPE ANNUAL LIFE CYCLE AND RELATED OPERATIONS

NOVEMBER-FEBRUARY:
dry pruning, brushing, residue raking and chopping, weed control, crop protection when necessary, earthing up where necessary.

Early bud swell | Late bud swell | Bud burst

MARCH-APRIL:
crop protection, weed control, fertilization.

APRIL-MAY:
crop protection

immediate prebloom | first bloom | full bloom

JUNE-JULY:
crop protection, soil tillage, green pruning, mowing.

buckshot berries | berrytouch/ bunch closure | veraison

SEPTEMBER-OCTOBER:
harvesting.

Ripe for harvest

Planting a new vineyard

FIELD FORMING

In flat areas, (slope <5%) the major goals are to avoid ponding and allowing for machinery traffic. Factors to be considered are permeability of soil and height of the water table, if any. Practices adopted are surface levelling, construction of adequate ditches or, better if financially possible, construction of a draining system beneath the surface of the future vineyard.
In areas with slope > 5%, the main objective is to avoid soil erosion and possible disastrous landslides and to allow for mechanization. Main criteria to be considered are then soil permeability, slope and risk of landslides; practice applied are construction of terraces.

SOIL ANALYSIS

As for all crops, soil analysis results are the base for fertilization decisions. Results can not be better than soil samples, so soil samples must be collected carefully and they must be as representative as possible of the whole plot. This is very important because analysis is performed on a sample of about 500 grams. Samples are token with a spade or a soil probe (left) at two the depths: 40 and 80 centimeters. On one hectare we need up to 10 sub-samples from two depths. If the soil in the plot field is homogeneous, then 5 sub-samples will do. If the plot is composed by different soil types, then better take 10 sub-samples per hectare. Sub-samples are then homogenized, soil aggregates are reduced and well mixed; store the samples in plastic bags. Samples from different depths obviously must be kept separated. Best time for sample collecting is fall, before the deep tillage operations necessary for planting a new vineyards.

TILLAGE

If the new vineyard will be planted on the place of an old one, then it is necessary to clean the soil from roots and other residues of grapevine plants .For deep tillage, down to 80 centimeters, rippers are preferred to traditional ploughs in order to avoid turning deep layers of soil, which can be unfit for cultivation. After that, ploughing to 40 centimeters deep is suggested. Harrows or rototillers are then applied to finish the soil and prepare it for young vine cuttings.

CULTIVARS AND ROOTSTOCKS, GENERAL

In most countries, the grapes grown today are varieties of just one vine species, **Vitis vinifera**.

Vitis rupestris, **Vitis berlandieri** and **Vitis riparia** are originally American species, which roots are resistant to Phylloxera, an aphid that in 1800 destroyed almost completely European vineyards: thus these cultivars are used as rootstock for production of grafts with Vitis vinifera. These species produce very poor-quality grapes but they are crucial for producing rootstocks resistant to Phylloxera: hybrids as **Berlandieri x Rupestris**, **Berlandieri x Riparia** and **Rupestris x Riparia** are used as rootstocks.

Aerial part of the plant is Vitis vinifera, giving quality grapes

Grafting point

Rootstock is hybrid between Vitis rupestris, berlandieri and riparia, giving resistance against Phylloxera.

SOIL MANAGEMENT

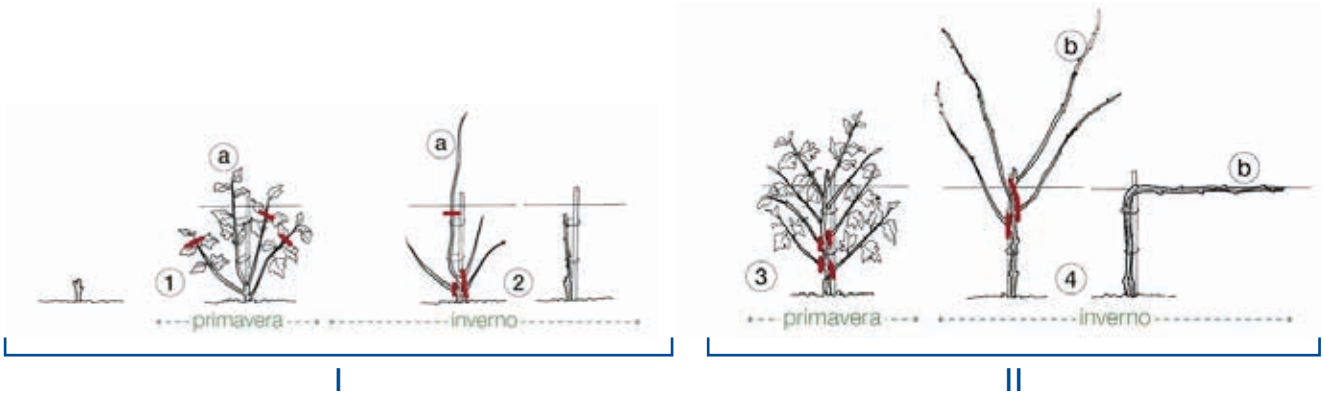
Historically, soil management in vineyards meant manual or mechanical hoeing and tillage to keep the soil free from weeds, thus avoiding competition for water and nutrients. Several factors have very much changed soil management practices in vineyard in the last fifty years; among these factors important are availability of fertilizers and chemicals, need of soil erosion's prevention, maintenance of soil chemical and physical fertility, need for better quality of the fruits and wine. In modern practice, **during the first two from four years**, tillage in light soils is performed regularly to keep off weeds and avoid competition of weeds with the young plants of grapevine.

Grasses are planted or allowed to grow into interrow spaces in order to get a "turf" in more heavy soils (clay, lime).,starting from the second year after the planting. It is not suggested to sow forage grasses because they compete strongly with young grapevines plants for water, nutrients and light; if sowing is needed, different less aggressive mixes are available for this goal.

The bands on the rows beneath the plants are kept free from weeds with tillage operations (specialized implements are used for hoeing, rototilling and the such) or herbicide band applications. Generally, starting from the third year from planting, the width of the tilled or sprayed band beneath the plants id adjusted between 60 to 120 cm, depending on the spacing between the rows. On the turfed interrow spaces, better conditions are created to allow machinery traffic also during wet periods. Compaction is decreased on turfed surfaces when compared with tilled surfaces.

FORMATION OF THE PLANTS

After two, three or, in some cases, four years from the planting of cuttings, the young plants of grapevine enter the production phase, which last 30-40 years (true, in Piedmont region some 350 years old vines exist, but this is only for history...). During the second and third year, plants are pruned for forming the structure of the a chosen training system, (e.g. Guyot, GDC, cordons, curtains and others); plants at this stage are not pruned for grape production. After formation, plants go through a annual cycle, which is divided is divided in two parts: vegetative and reproductive.



Formation pruning during the first two years to obtain a cordon training system. For other systems, the pruning is similar, but different shoots are cut or left.

BASE FERTILIZATION

Base fertilization is the operation which brings important quantities of nutrients (P and K) to the soil, in order to restore or increase the natural bank of soil fertility, allowing for sufficient levels of nutrients during the normal cycle of vineyards. No supply of N is suggested at this stage, because N can be added every year during operations for production fertilization. If possible, application of manure is always very useful in order to improve the chemical and physical fertility of the vineyard. As guidelines, a content of soil of 1,5-2,5% in Organic Matter is sufficient for satisfactory growth of grapevine. Levels of of 20 - 50 ppm of assimilable P2O5 (Olsen) and 140-200 ppm of exchangeable K2O are considered consistent for grape production.

TRAINING SYSTEMS AND POPULATION

Choice of training systems and thus of planting density depend on many factors, of which most important are:

- Climate, meaning temperatures and availability of water
- Fertility of soils
- Cultivar and thus productive potential of plants
- Buds' distribution and quantity, per plants or hectare
- Desired quality of grapes
- Grape for wine production or table (fruits)
- Possibility of mechanization of operations as pruning and harvesting

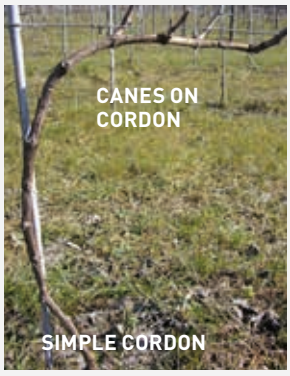
This list is not exhaustive, and the factors are not listed in order of importance; anyway it gives a good idea of the complexity of the problem. Luckily, where grapes are cropped, there are rich local experiences which can help in making decisions. As a rule of thumb, moist climates and rich soil allow for "high" training systems, as GDC, curtain, "pergola"; where conditions are not that favourable, Guyot and cordons are chosen. In general the higher the quantity of fruit, the lesser the quality; as a consequence, training systems as Guyot, simple cordons, Sylvoz, which bear less buds, are indicated for production of high quality wines; curtains give more production but also less quality. Of course, these are very general rules, because the final result will depend not only from the chosen training system , but also from the climate and intensity of winter pruning, **which is the removal of vegetative parts to establish and maintain the vines in a form that will reduce labour, facilitate cultivation, help control insects and diseases, expedite harvesting and improve quality**. Possibility of mechanical pruning and harvesting is extremely important for economical results of operations: adequate mechanization on sufficient acreages means lower production costs. The planting density is always correlated to the type of farming, environmental fertility. Generally, higher densities are applied in less fertile areas (5-6,000 plants /ha). **At the end of the day, the density of plantation per hectare is determined by the spacing between rows (1.30 –4.5 meters) and the space between vines (0.5- 1.5 meters). Thus, density can vary from 3,000 vines (table wine) per ha to 10,000 vines (Margaux appellation) per ha. High density will favor concentration of aromas in the berries and better quality of the wine produced. However, it will also increase the cost of production and require specially adapted equipment and additional labour.**

TRAINING SYSTEM	INTERROW SPACING (meters)		PLANTS SPACING (meters)		POPULATION (plants/ha)
	Specialty tractor	All purpose tractor	Vigourous cultivars	Weak cultivars	
SYLVOZ	2.70-2.90	2.90-3.10	1.50	1.00	2150-3700
SIMPLE CORDON	2.30-2.70	2.90-3.00	1.00	0.80	3333-5434
COURTAINE	2.50-2.70	2.90-3.00	1.00	0.70	3333-5714
DOUBLE CANE	2.30-2.70	2.90-3.00	1.10	1.00	3030-4347
GUYOT	2.30-2.70	2.90-3.00	0.90	0.70	3700-6211
GDC	3.50-4.00	4.00-4.50	0.80	0.50	2777-5714
PERGOLA	3.70-3.90	3.90-4.10	1.00	0.70	2439-3861

TRAINING SYSTEM	MECHANIZATION		SUGGESTED POPULATION	PRODUCTION	QUALITY	SOIL FERTILITY	WATER AVAILABILITY
	Harvesting	Pruning					
SYLVOZ	yes	no	mid-low	high	middle	mid-high	mid-high
SIMPLE CORDON	yes	partial	high	low	high	low	mid-low
COURTAINE	yes	yes	middle	middle	middle	high	low
DOUBLE CANE	yes	partial	middle	middle	middle	middle	middle
GUYOT	yes	partial	high	low	high	low	mid-low
GDC	yes	yes	middle	high	middle	high	middle
PERGOLA	no	no	mid-high	high	middle	middle	middle

Source:Guida per il viticoltore, AA.VV, Azienda Regionale Veneto Agricoltura, 2004

VINE TRAINING SYSTEMS



Production vineyards

PRUNING

Pruning is an operation carried out in winter on wooden organs of the plants ("dry" pruning). In viticulture, it consists in cutting and removing old wood ("brush", "brushing"), which already produced grape, leaving on the plant only fruiting canes for next year grape production and/ or spur(s) for future fruit canes production. "Cane pruning" or "spur pruning" practice depends basically on the training system adopted; e.g. in Guyot only one cane (6-10 buds) and one spur (two or three buds) are left; in cordon 4-5 spurs (two to four buds each) per meter are left. The principle is the same: canes which have already given fruits are totally or almost totally cut, spurs (which is the basal part of cane with two to four buds) are let in order to give new canes and new production in the next year. Pruning is a crucial operation because it is possible to decide the number of buds per plant, (and therefore per hectare) in order to equilibrate the vegetative and reproductive stages of the grapevine plants and obtain proper quantity and quality of berries, depending on final production, which is wine or fruits. Mechanical pruning and pre-pruning is already largely practiced with mounted implements that cut the bulk of brush off the plants and prepare them for a more precise manual pruning: estimated productivity increases from 4 to 10 times when compared with manual work. E.g., the following chart bears the charge of buds left after pruning for different areas in Northern Italy (45° North) and depending on the training system adopted. The number of buds per hectare left after pruning is on average from 50.000 to 150.000 buds. This great variability is due basically to differences concerning cultivars, training systems and climate and soil conditions.

PRUNING: RECAP

Buds load suggested depending on chosen training system in different areas of Northern Italy (Numbers of buds left per meter of cane or cordon)

AREA: HILLS, MODERATE CLIMATE	
GUYOT	10-12
CORDON	8-10
CASARSA	10-15
SIMPLE CURTAIN	10-15
GDC	10-15

AREA: FRANCIACORTA	
GDC	10-15
SIMPLE CURTAIN	10-15
CORDON	10-12
GUYOT	10-15
DOUBLE GUYOT	12-15

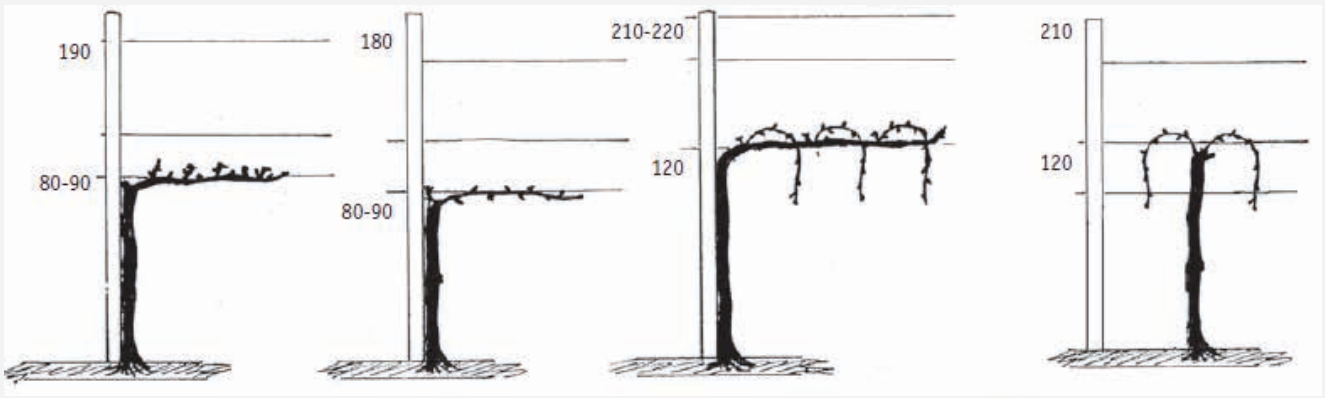
AREA: ALPS VALLEYS	
GUYOT	10-12

AREA: PLAIN, HOT CLIMATE	
GUYOT	12-15
CORDON	10-14
SYLVOZ-CASARSA	6-20
GDC	12-16
PERGOLA	15-25

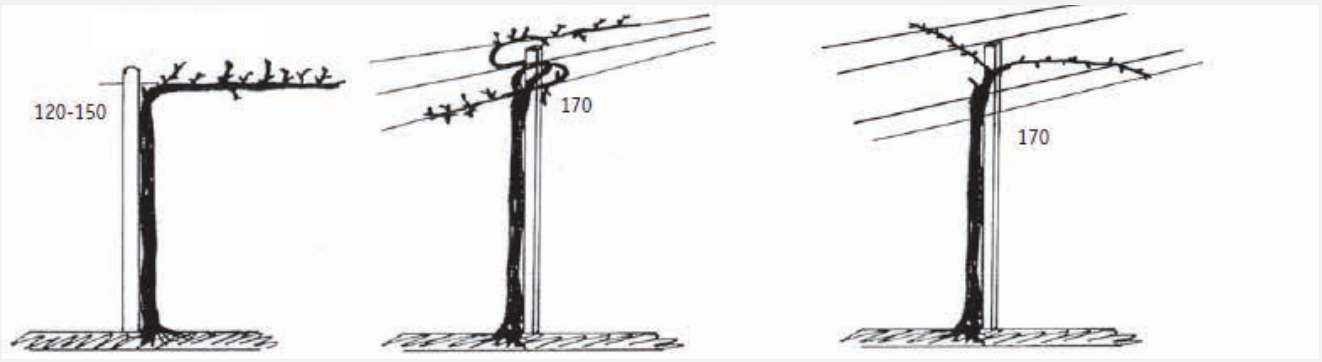
AREA: PLAIN, HOT CLIMATE, VERY FERTILE SOILS	
GDC	10-15
SYLVOZ-CASARSA	15-25
DOUBLE GUYOT	15-20

It is possible to increases the buds load up to the 20% more.

TRAINING SYSTEMS AND PRUNING



Cordon spur trained | Guyot | Sylvoz | Double-cane



Simple curtain | Geneva double curtain (GDV) | Pergola

TRIMMING

"Dry" or "winter" pruning is not the only practice which influence the canopy of grapevines. During the summer more operations are needed, the so called "green pruning", specially for high quality wine production. **Trimming** consists in cutting at a certain height the canopy of the grapevines. The first result is a renewal of the foliage: plants react to the cutting forming new leaves, which are more efficient in photosynthesis than the old ones. As a consequence, fruit are better fed and wine is quality. Another results is keeping the plants in a consistent shape for successive access to the vineyard. How much foliage is to be cut? A rule of thumb says that it is necessary to keep 10 leaves on the cane past the last grape. Suggested timing is between fruit set and veraison from the middle of June (better) to beginning of July.

DEFOLIATION

This practice consists in taking off some leaves around the bunches of grape, thus improving their exposition to the light and the microclimate. This operation is not suggested on white cultivars, because an excessive exposure of the bunches to sunlight results in a too high temperature of the berries, which means also a drastic reduction of the acid content (see malic acid) and of the potential aromatic grape. For red grapes, on the contrary, a good exposure to the sun improves the coloration of the berries as a consequence of an anthocyanin synthesis flow on higher levels. Evidences are that best exposure to the sun gives an increment of 30% in the content of coloring substances in grapes. Defoliation can be performed both manually and mechanically: of course, manual defoliation is extremely expensive and justified only in case of production of premium wines. The operation is performed in the vicinity of veraison, just removing leaves that actually hinder the insolation of the grapes, broken and sick leaves. It is important to let enough leaves for correct bunches nutrition.

FERTILIZATION

As for other crops, production fertilization aims to keep a balance between soil fertility and yield requirements. After base fertilization, soil analysis carried out every 5 years are the base for decision making. Contribution of organic fertilization (manure) should be included in calculation of annual rates of N, P and K. The leaf analysis can be performed to diagnose mineral elements or, more generally, to assess the nutritional status of the vineyard. Foliar fertilization are recommended only when certain deficiencies of particular nutrients are surely assessed.

Phosphorus and Potassium (PK)
P and K are less mobile nutrients than Nitrogen into soil, the bulk of them should be applied during base fertilization before the implantation of the vineyard. Only if soil or foliar analysis results assess a shortage, applications are needed.

Nitrogen
N fertilization will be performed on the same base. N is mobile into soil so rates should be decided on the bases of requirements of plants and losses of the nutrient. N applications should be fractionated during the season to reduce losses and better calibrate the availability of the nutrient during the time: however, for annual inputs of less than 40 kg / ha, it is possible to make a single distribution. As guidelines, total removal of nutrients from soil (berries and brush from pruning) have been assessed as follow:

10 tons of grapes take 60 kg N, 13 kg of P2O5, 83 hg K2O and , 17 kg MgO
25 tons of grapes take 104 kg N, 27 kg of P2O5,144 K2O and 36 kg MgO

Suggested timing for application of fertilizers is for applying about the 30% in Autumn after harvesting and 70% in spring, at the beginning of vegetation period.

SOIL MANAGEMENT AND WEEDS CONTROL

During the productive period, on rough average 30 years, it is necessary to provide consistent soil conditions, which allow for better fertility, productivity and easy access to vineyard. As we know, grapevine is cropped in a huge area with many variations of soils, climatic conditions, training systems and pruning; nevertheless, two policies are basically possible:
Classic tillage on the interrow spacings, meaning that the interrow space is tilled with rippers, rototills, disk harrows and the such, when the space beneath the rows is or tilled or chemically treated for weed control
Creation of a turf in the interrow spacings, thus avoiding routine tillage operations, with chemical or mechanical (or both) weed control only beneath the rows. The turf is mowed during the season, to control the growth of weeds. Both patterns have pluses and minuses.

Tillage is carried out with an array of implements, similar to implements used in cash crop farming, but narrower.
The simplest way to have a turf is to allow the growth of local species.

	TILLAGE	TURF
PLUSES	Almost total weeds' control	Almost total weeds' control
	Higher capacity of stocking water from precipitations (in plain soils)	Better accessibility during wet periods, bearing capacity increased
	Mixing and chopping of residue and pruning materils into soil, thus improving the OM content	Risk of erosion on slopes diminished, less ponding
	Because of the destruction of vegetation between rows, no plant can host insect parasites or fungi detrimental for crop	On the long term, improvement of soil structure and OM content, less compaction and no hard pans
	----------	On average, less expensive because of lesser fuel consuming
	----------	Better dynamic of nutrients, better translocation of P and K into soil
MINUSES	Tilled wet soil makes difficult accessibility of machinery for spraying, harvesting and other mechanized operations, thus delaying these practices	Turf, if wrong managed, competes with grapevine for nutrient and in some cases, for light
	On the long term, compaction of soil is likely, as well as formation of hard pan is more likely	In dry climates without irrigation, turf severely competes with grapevine for water. Worst situations are likely in light soils
	Grapevine plants can be damaged by working tools of implements	----------
	On slopes, water erosion and landslides become more likely	----------
	On average, more expensive because higher fuel consuming	----------

Crop Protection

FUNGI	TIMING OF APPLICATION	CHEMICALS
Downy mildew (Plasmopara viticola)	**Until pre blooming**	Cupric products
	Apply promptly 1 or 2 days before the end of the incubation period using hedging products. Alternatively, you can intervene with curative purposes using mixtures containing fungicides endotherapic, within 2-3 days from the beginning of the presumed infection.	Etilfosfito aluminum
		Azoxystrobin
		Dimetomoroph
	From pre blooming until fruit setting	Cimoxanil
	Apply a precautionary treatment with long-lasting fungicides or wait for an alleged infecting rain and then apply, within 2-3 days, a tank mix containing endotherapic. Keep the canopy protected applying endotherapic fungicides.	Benalaxil
		Metalaxil
		Oxadixil
	After fruit setting	Mancozeb
	Basically applications of cupreic chemicals	Metiram
		Famoxate
Powdery mildew (Uncinula necator)		Sulphur
	High risk areas	Azoxystrobin
	From bud bursting to pre bloom, early applications with contact fungicides. From pre- flowering , apply systemic fungicides alternately with sulphur.	Fenarimol
		Nuarimol
		Miclobutanil
		Esaconazole
	Low risk areas	Penconazole
	Spraying should begin after fruit set, repeating the applications depending on climate condition and actual presence of the disease.	Triadimenol
		Ciproconazole
		Tetraconazole
		Propiconazole
		Fenbuconazole
		Pyriphenox
		Quinoxifen
		Ampelomyces quisqualis
		Tebuconazole

Grapevines are damaged by a long list of parasites as fungi (most formidable), insects and viruses. E.g. the charts above show the complexity of the protection means applicable against two of the most dangerous fungi disease of grapes, which also nowadays, if undetected, can completely destroy the yield. Against Plasmopara viticola, applications should begin between the stages of shoots length 10 centimetres and pea sized berries. For powdery mildew (Uncinula necator) the spraying starts immediately prior to grapevine blooming. Infections depend both on rain and temperature regime. These two examples show that preventive control of primary infection and following accurate management during the whole season are crucial for managing the diseases. Basically, fungicides and insecticides can be divided by way of action: "contact" and "systemic". Contact chemical cover the foliage and kill the parasites, but they are flushed away by rain and do not enter the plants, thus they do not have therapeutic effect against infections. As a consequence, it is necessary to repeat the spraying after every rain, on average 1 time in 7 days during the season. Systemic chemicals enter the plants, kill the parasites and their action is longer, on average one spraying is needed in 15 days. For improving crop protection and decreasing the amount of applied chemicals, growers are adopting integrate crop protection systems: this means that they use different tools for monitoring the actual presence of insects or the probability of starting infections in order to precisely know when it is absolutely essential apply chemicals. Nevertheless, during the season, several treatments are carried out with specialized spray dryers that deliver chemicals on all parts of the plants' canopy with great precision. Operators must be protected from chemicals: active carbon filters mounted in the air conditioning system of cabin are mandatory for operator's safety. As a whole, spraying can amount up to the 55% of tractor activity in vineyards.

Irrigation

Traditionally in Europe grapevine has been cropped without irrigation, also because the plant is physiologically rather resilient to drought. About 600 millimetres of precipitations per year are sufficient for obtaining good quality grapes and thus quality wines, if precipitations are regularly spread during the season. As a whole, this value is well below the average precipitations' value common in North and Central Europe: in South Europe rainfall can be less than that. More, in areas where excellent wines are produced (AKA designation of origin guaranteed and protected), irrigation is often forbidden by local production protocols, in order to avoid a worsening of the grape quality, which means an increasing of the ratio between water and sugars contents inside the berries. However, if the natural precipitations are not sufficient for viticulture or drought is severe, grapevine plant suffer and also quality of product gets worst: in these cases irrigation is justified and necessary as "rescue irrigation" or "deficit irrigation", that means applying the minimal amount of water only during drought period or/and drought sensitive stages of plants' growth. Most sensitive stages for grapevine are between fruit set and veraison. Drip irrigation is the most rational method for irrigation in vineyards (not the most cheap); this method does not allow for spreading of diseases and it is possible to reach an high water efficiency, meaning less losses of irrigation water and less volume of water necessary per hectare. More, in this way only the band beneath the rows is irrigated, and only this band must be tilled, thus allowing for keeping turf on interrow spaces and for precise application of fertilizer where they are needed.

Harvesting

The fruit of grapevine is a berry, the whole of berries make a cluster or bunch of grapes. Parts of berry are skin, seeds and pulp. Skin contains anthocyanins, which give color to vine. Seeds contains tannins, responsible for astringency of vine. Pulp contains water, sugars(which fermentation gives alcohol and carbon dioxide) and organic acids, which have influence on vine taste, acidity, stability and color. Of course, each cultivar differs from other; as guidelines, the berries are ripe when water content is 70-80%, sugars are from 15-24% (ratio is glucose: fructose = 1:1) and organic acids (mostly tartaric and malic) are between 4-10%. Different quantities and ratios of these compounds explain the huge variation of flavor in vines after the process of fermentation. Content in sugars is determined by testing the juice with a Brix refractometer, and this helps in determining the stage of maturation; in conjunction with chemical tests also a berry sensory analysis is possible, based on 20 descriptors as berry color, sweetness, acidity and aroma.

Harvesting (as well as pruning) is the most labor demanding operation in vineyards: both manual and mechanical patterns are possible. Mechanical harvesting is a crucial operation in medium and large sized vineyards: this is so important, that older grapevine training systems have been modified in order to allow this operation be performed. New forms of training system have been "invented" to make possible mechanical harvesting. For vineyards, both self propelled and pulled harvesters are available. Self propelled harvester are extremely productive when pulled harvester are more economical. Pulled harvesters are yet he most popular type and they require a tractor with about 90 HP to be operated: both for self propelled and pulled harvesters, interchangeable kits of tools are available for performing other operations as pruning and spraying, thus allowing for a longer period of exploitation of machinery during the season. Mounted harvesters are also available for little farms. Estimations in North Italy show that mechanization of operations as pruning and harvesting in vineyard can decrease labor's requirements from 400 down to about 200 hours*man per hectare per year. This means that mechanical harvesting is crucial in maintaining the farm rentable.

Vineyards machinery

MANAGEMENT

During the planting season and the production's years, NH specialty tractors can perform all the necessary operations from tillage to harvest.



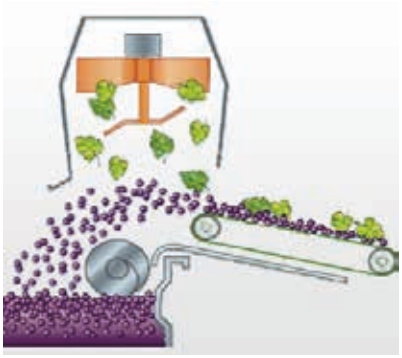

HARVESTING

NH grape harvesters are straddle-type: 2 wheels on each side of the row. It does not damages the canopy, but interspacing size must be fit for access to the rows.

A set of shaking rods on each side, with curved shape allow for softness and respect for berries and stocks: the Shaker Dynamic Control lateral alternative movement gives acceleration to the canopy, not to the trunks.The heavier berrieser) fall down, when leaves and stems remains on vine stock.

2 chain of baskets on each side receive the falling berries from shaking system. Ground losses are minimal because of the perfect sealing.Full respect and no damage to the stock.

Working height is adjustable. Vertical type trellis systems are better fir to be harvested mechanically. The height of the poles and the material they are made of are crucial to consistent results in harvesting.

Berries are unloaded from the Noria in two tanks, the crop is spread onto belt conveyors: in the meanwhile, suction fan cleans harvest from leaves and other unwanted material. Fan speed is adjustable for fine tuning of cleanliness expected.

The harvester unloads the product into trails pulled by a tractor. The berries are ready to be processed. Thanks to an hydraulic system, the entire machine lifts itself, putting the harvesting head at the right height for harvesting: thus, it is possible to adjust shakers' height at he same height of grapes and facing the fruits. Vertical training system are more fit for mechanical harvesting. Baskets are placed below the lowest fruits, and above ground, thus allowing for harvesting when the training system is "low". Most important functions of the harvester are managed by by the multifunction handle on driver armrest. Harvester can afford working on slopes up to the 30%.

All working parameters are adjustable from the cab through Intelli View II New Holland touch screen:

- Shaking speed (nb of shaker movements per minute).
- Conveyor speed (rpm)
- Fan speed (rpm)
- Travel speed (kph),
- Etc..
- Parameters can be adjusted while working and the system then ensures that the chosen settings are maintained.

Braud can be equipped with kits for pruning, trimming and spraying.

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