Sustainable Development in Viticulture

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***Abstract**: In order to remove the negative characteristics of industrialized viticulture, a series of alternative technologies have been introduced in the world to eliminate the sources of pollution for the wine-producing environment, to guarantee non-toxic products and to lead to a high economic efficiency. The main alternative technologies used in viticulture, which are links of sustainable development of this sub-branch of agriculture, are: biodynamic viticulture, biological (organic) viticulture and ecological viticulture. The paper presents the main technical and economic characteristics of the lines of sustainable development in viticulture, which can be applied in the Romanian vine plantations.*

The present dimension of economic increase has two distinctive and contradictory aspects. One is the unprecedented accelerated growth of labor productivity and implicitly of production based on scientific progress and contemporary techniques (mechanization, automatization, chemicalization of production processes, genetic engineering, etc). The other is the size of present day consumption, which has put tremendous pressure on the environment factors. There are more and more obvious phenomena of ecological balance deterioration, of polluted environment factors, of reduced vegetable and animal genetic fund with unpredictable consequences on the future of mankind.

In order to solve the above-mentioned contradiction, there has to be a concerted action as it is not just an issue of economy or political vision but also an issue of morals, ethics and respect for the future. "We borrow from the next generations an ecologic capital, knowing for sure that we will not be able to return it. They will have the right to call down to us that we have been so wasteful, but they will never be able to retrieve what we owe them. We act like this because we have no one to account to: the next generations do not vote, they have no political or financial power, they cannot stand up to our decisions"[1].

In these circumstances, a new concept of economic growth has come into focus, which is a priority for the next century and namely sustainable economic growth. The concept of **sustainable development** implies "to satisfy the needs of the present without compromising the ability for the future generations to satisfy their own needs.".[2]

Agriculture and industrialized viticulture of our century, developed on the basis of intensively chemicalized and mechanicized technologies have led to problems that can affect a supreme value criteria and namely human health due to environment and food degradation.

The industrialized viticulture of the last decades characterized through massive vine plantations that allowed intensely chemicalized and mechanized technologies have a negative impact on soil and on the environment in general and implicitly on human health due to the following characteristics:

- it ignores a fundamental law of biosphere – diversity – maintaining the vine growing plantation as monocenosis (with a duration of decades);;
- it affects the essential attributes of soil fertility: microfauna and microflora, humus, structure (oxygen, water, heat);

[1] Ion Iliescu – Probleme globale ale omenirii, Publisher Tehnică, Bucharest, 1988 p. 11.
[2] Camelia Cămăşoiu – Economia şi sfidarea naturii, Publisher Economică, Bucharest, 1994, p. 13.

- due to cleaning at a large depth from plantation (60-80 cm) it takes the aerobian bacteria deep under ground and takes the anaerobic ones out to the surface;
- it destroys the soil structure and accelerates the mineralization of the humus through repeated action of machines (around 30 actions during the vegetation period);
- it reduces the microflora and microfauna through toxification;
- it directly affects human health through the use of billions of toxic phyto-pharmaceutical molecules.

These technologies naturally integrate the vine growing plantation into the environment while industrialized viticulture simplifies the plantation's role to that of a "grape-producing factory" functioning with a growing effort for people. At the same time, it ensures increased economic efficiency by removing the main shortcoming of traditional or family viticulture.

The respective technologies promote an agriculture that compels to important restrictions as concerns the use of synthesis fertilizers and pest control substances and therefore, many of the technological links are common within alternative agricultural technologies. The EU countries use three terms to refer to the same thing (biological agriculture): in France, Italy, Portugal, Greece, the Netherlands the term "biological" is used; in Germany, Spain and Denmark, the term "ecological" is used and in Great Britain, that of "organic"[3].

In Romania, through the Emergency Decree no. 34 of April 17th 2000, the term "ecological food products" and namely "ecological agriculture" are used.

Alternative technologies were born as a response to the challenges of the 20th century within theoretical and practical movements. Their short description allows us to identify common points, characteristic traits and specific objectives for vine growing.

A. Biodynamic viticulture is a branch of biodynamic agriculture. It was initiated by Rudolf Steiner (1861-1925) in Germany and then developed by Pfeiffer. Biodynamic agriculture was base don a philosophical theory elaborated at the beginning of the 10th century as a reaction to the development of materialist philosophy from that age.

Biodynamic technology elaborated initially added to the extant practices from peasant farming a series of new methods aiming to dynamize and balance biological products by using natural ingredients capable of accumulating energy and information (both from the Earth and space) that it then distributes to the biotic environment accelerating the growth and development processes. Later on, the enzymological studies proved the active role of bio-catalysers in different fields.

Biodynamic agriculture takes into account the cosmic influences on plant growth, the Earth's magnetic field and the currents in the soil etc., and therefore it is necessary to use a calendar of the main agricultural activities.

The technology of biodynamic viticulture recommends the use of 9 substances (numbered from 500 to 508) prepared from herbs, dung and natural silicates with positive actions on the development of plants (stimulate growth, speeds maturation and fight diseases and pest). There are special recipes to prepare and apply these products. For instance, an efficient fertilization of vines according to the principles of biodynamic agriculture can be achieved through one of the following options:

- manure, 30-40 t/ha;
- ovine manure, 10-15 t/ha;
- biodynamic compost, 5-15 t/ha;
- green fertilizers.

Of course, the respective dosages of fertilizers are approximate and must be adapted depending on "soil fertility, fruit load and destination of the crop". During spring, the following

[3] Gh. N. Iosif, and others – Ecomarketingul Societăților Comerciale, Tribuna Economică, Bucharest, 1999, p. 27

fertilizers can be used: finely ground potassium salts, wood ash, siliceous rocks finely mined and foliate fertilizers.

Soil works aim to mobilize the surface layer avoiding the repeated activity of machines; weeds are destroyed through weeding and rational crop rotation.

Diseases and pest are fought by using strong breeds, natural products (for instance nettle left to steep) and favouring the development of insects and animals that destroy the parasites.

B. Biological (organic) viticulture is a branch of the same type of agriculture and it first appeared in Great Britain after the second world war. This type of agriculture places the accent on biologic balance and soil fertility accomplished naturally. The founder of the theory was Albert Howard, who, for decades, made a series of research in India and published his result in 1940 in "An Agricultural Testament".

According to his scientific observations, due to unrational use of anorganic fertilizers, the soil lost its granular structure, reduced its content of organic matter and the natrium-fixing bacteria have almost disappeared. Therefore, biological agriculture implies "to stop using chemical elements as the necessary of nutritive elements can be covered through unconventional means"[4]. Keeping the living beings in the soil alive (and especially bacteria) makes it possible to draw and fix the nitrogen and a true crop rotation that includes the plantation of vegetables contributes to keeping the nitrogen in the soil. Potassium can be covered through burning the vegetable remains and phosphorous will be taken from other organic matter.

Biological agriculture enjoys extended support within the EU as it corresponds to the new objectives of the Community agricultural policy: balance the demand and supply of food products, environment protection and rural space protection, guarantee the requirements for loyal competition between producers and the free circulation of products. The restrictions promoted by the CEE Regulation no. 2092/1999 regarding the means of biological production of agricultural products specify:

1. The biological fertility and activity of the soil must be maintained or improved by:

a) crops such as leguminous plants, green fertilizers or others within corresponding multianual rotations;

b) including organic matter in the soil (composted or not) whose production is ensured by the exploitations that correspond to the requirements of this regulation (animal sub-products can be used only if they come from exploitations that meet the requirements for biological production);

2. Fighting parasites, diseases and weeds is done as follows:

- An appropriate choice of species and varieties;
- Adequate programmes for crop rotations;
- Natural means (fire, birds, etc.).

3. In order to pass from a conventional agriculture to a biological agriculture, a minimum period of reconversion must pass: 2 years for annual crops and 3 years for perennial crops. The respective period implies restrictions as regards the sale of agricultural products obtained in the respective time frame.

The vine is a perennial plant and therefore, the principles and objectives of biological agriculture embrace a series of particularities. For instance, crop rotation is out of the question as it takes many years to start and exploit an agricultural plantation.

The technology used in biological viticulture contains the classical links of any technology: soil works, fighting weeds and pest, the choice of grape types with biological characteristics of increased resistance.

[4] Gabriel Popescu – Probleme de politică agrară, Publisher ASE, Bucharest, 2001 p. 42.

Soil works are mechanized to be efficient but they must disturb as least as possible the soil's microbian activity, maintain its structure and is accomplished as follows:

- soil mobilization and aeration is done without destroying the beds and depth incorporation of superficial layesr so as not to destroy the humus and not to disturb the micro-biological activity from the soil surface. In the well mobilized and aerated soils, the roots enter easily without being choked;
- a superficial incorporation of fresh organic matter (plant residues, green fertilizers, fresh organic fertilizers) so that it is first humified in an aerobian environment;
- soil settlement is to be avoided by reducing the use of heavy machines that have a negative effect on structure, aeration and biological activity;
- maintenance works are carried out at the appropriate time;
- subsoiling, without mixing the layers must be carried out at the end of summer or in autumn. It is recommended for poorly drained and poorly aerated soils;
- ploughing (autumn, spring) is executed without burying the "living" surface levels;
- avoid using machines that break down the soil excessively;
- mechanical soil works are completed with those of living organisms in the soil.

Grassing between the vine lines is a frequent practice in biological viticulture. It may be done naturally or artificially.

Natural grassing is very simple but also presents some inconveniences: the soil grassing is slow and not uniform; it provides low protection against soil erosion and compaction; the species are not all as useful due to increased water consumption, excessive growth, etc.

Artificial grassing is done with useful grass species and it ensures a quick and uniform coverage. It is applied in areas with yearly rain falls of 600-700 mm, of which at least 250 mm are during the months of May to August. Use of graminacaea mixes is recommended (3-5 species) that are characterized through reduced water needs, resistance to shadowing.

The beneficial effect of grassing is economic as it decreases expenses with maintenance ploughing and weeding but also indirectly in ensuring the requirements necessary for vine growth considering that:

- grassing balances physical, chemical and biological phenomena taking place in the system soil-plant (L. Sicher and collab. 1993);
- it intercepts rain falls and protects structural aggregates from the impact of rain drops (A. Klik, 1991);
- it diminishes the speed of surface water flow
- it ensures a better infiltration of water, following the presence of macropores in the soil.

The chemical characteristics of the soil are improved through grassing as:

- organic substances are produced on the spot, through a repeated mincing of green mass – which is kept on the surface and part of which becomes stable humus;
- the nitrogen content is smaller than in black soils, which improves the quality of grapes;
- the content of K_2O is moved in-depth by the roots and is used extensively by the vine. Grassed soils show biological activity through an increased percentage of CO_2 met in such soils (P. Fleck, 1979; E. Homnghausen, 1980). The tight link between the content in organic carbon and soil breathing is due to biodegradable organic substances that serve as nourishment for micro-organisms, which, at their turn need an edaphic balanced microclimate;
- the frequency of earth worms is higher in grassed soils that in black soils;
- heterotrophic organisms are especially important for some biological processes in the soil such as: mineralization, humification, nitrogen fixation and stabilization of structure. On the grassed fields, these organisms are almost twice as many as in black fields;
- on grassed soils, the spores of mycoriphic mushrooms and the degree of micorization of vine roots have increased values (P. Nappi and collab. 1980-1981).

Weed fighting in biological viticulture is based on that weeds are not thought to be "enemies" that must be destroyed but they are rather resources that must be managed properly; it is recommended to stop their exaggerated multiplication in certain periods as it competes with the development of vines. Other than these periods, the weeds may have favourable effects ensuing soil protection and a stimulation of biological activity through the root samples.

In order to avoid the multiplication of weeds, the preventive actions to be taken are:

- suppress sources of dissemination such as fresh manure that contains potential weed seeds. Through an appropriate compostation, their germination capacity is reduced;
- spring ploughing takes place early so that the seeds brought to the surface have the time to germinate and then be destroyed through superficial works;
- soil mulching as a procedure of fighting against weeds contributes to soil protection from excesses of clime and maintaining the humidity in dry periods. Vegetable remains are used: straws, leaves, various composts, manure, tree bark, etc.
- using permanent grassing or green fertilizers.

Fertilization of viticultural plantations is carried out by using green fertilizers and organic matter from the farms. Various plant composts can be used.

The use of green fertilizers is a recommended alternative of soil fattening in biological viticulture.

The culture of annual plants on the intervals between the rows used as green fertilizers influence in a positive manner the physical, chemical and biological characteristics of the soil, without affecting growths and fructification of vines.

Species with a short cycle of vegetation can be used as fertilizers as they have a quick growth, produce large biomass and some (vegetables) can fix the nitrogen from the atmosphere. Seeding takes place in summer or autumn.

(Organic) fertilization implies using organic fertilizers that come from a farm (manure). It influences the level of soil humus and it maintains biological activity at the soil level in optimum conditions.

Dr. Maria Iliescu proposes a specific and interesting experience for the Târnave vineyard, and namely ***the use of compost from wood waste*** as an alternative to organic fertilization. The compost comes from the Wood Processing Works of Blaj (STRATUSMOB S.A.) and it came from a natural fermentation of wood refuse with the residual waters from fodder yeast.

The chemical composition of the compost from wood refuse recommends it as an alternative to manure, as the latter is harder to find due to the decreasing number of bovines and ovines (in 2000, half as compared to 1989). The compost contains in average 34% organic matter as compared to 18% as manure contains and the contents of nitrogen, phosphorous and potassium are 50% higher.

The use of wood refuse compost as an alternative for the organic fertilization of Târnavelor vineyard vines will have positive technical and economic outcomes such as:

- it stops the degradation of soil quality;
- it increases the level of supply with macro and microelements in the soil;
- harmonious development of vines (increases resistance to frost and diseases);
- constant grape production at an optimum quantitative and qualitative level;
- improvement of the physical and chemical composition of grape juice as a result of sugar and noble compound accumulation in the grapes;
- avoid accidents during the fermentation of the alcohol as a consequence of an increasing content of nitrogen and aminoacids in the wine;
- increased percentage of wines that can fall in the category of "wines with a controlled origin name", with positive effects on the offer and price of sale on the internal and external market;
- reduced risk of pollution of soils and implicitly of wine products.

The experiences conducted during several years with this alternative of biological fertilization have shown that the optimum dosage to apply the compost from wood refuse is of approx. 40 t/ha, onece every 5 years, which led to a production increase of 2000 kg of grapes annually as compared to a witness option and an additional income of almost 500 $/ha.

The vine protection is carried out according to the recommendations of the International Organization for Biological Control of animals and plants (IOBC) and implies the use of living organisms or of their products to prevent or reduce losses caused by damaging organisms.

Biological agriculture prohibits the use of synthesis pesticides whose long term effect on health is unpredictable.

The preventive methods for biological control are:

- to chose more adapted and resistant types to set new plantations;
- to increase the plants' resistance through several techniques of crops;
- natural selections and create a favourable auxiliary environment to increase the resistance of vines to Botrytis cinerea.

The methods for biological control imply the use of parasites and predators that consume eggs, larvae and chrysalis of pests (local or imported, found in nature or artificially bred and launched in plantations), micro-biological control (use of viruses, bacteria, fungicides), hormonal and anthocian control.

In order to protect the vine from viruses and bacterial cancer, it is recommended:

- remove and burn the ill plants;
- only plant healthy vines, tested for the presence of viruses;
- plant vines only on fields that have not been cultivated with vine for the last 3 - 5 years;
- in the case of thread worm attacks, the vine can be planted after 5-10 years, during which plants that have not been affected by thread worms are to be planted in crop rotation;
- the use and re-plantation of vines from grafted types resistant to thread worms;

The use of resistant varieties in biological viticulture is based on recently obtained hybrids (3rd generation) that have a decreased specific taste, the wines have more alcohol (10.5-11.0% alcohol) but have a more reduced resistance to phylloxera, which requires grafting as with noble varieties.

The following resistant varieties are accepted for personal use in our country: Brumăriu, Purpuriu, Moldova, Muscat de Poloschei, Perla de zala, Seyval and Valerien.

The Research-Development Station for Viticulture and Vinification Blaj (SCDVV) experimented with a series of biological technologies to fight diseases and pest, and the results obtained recommend their generalization in the biological growth of vines. For instance, acari control is achieved through the surface colonization with their predators, namely with typhlodroms. The technology is justified as treatments with pesticides have damaged the natural balance in the system typhlodroms/acari in favour of the latter, producing a massive reproduction. The method is based on a natural antagonism between animal eating species (typhlodroms) and plant eating species (acari) that are the food or prey for the former. Although recently approached in practice, the method has had remarkable results in the vineyards in Switzerland, France and Germany.

Biological control of mildew and grey dote is achieved by SCDVV Blaj though the use of compost extract (manure). The active components in the compost extract include bacteria, phenol acids and aminoacids, which provide an effective control of these diseases and it is a very efficient plant fertilizer.

The results obtained on the experimental batches proves that biological viticulture is a method of production connected to traditional knowledge and which integrates scientific progress of all agronomic fields. One of its main objectives is to protect the biosphere and the planet's resources. It excludes the use of chemical fertilizers, synthesis pesticides and herbicides. When fighting against pest, diseases and weeds, preventive actions and optimization of plant development conditions hold a special role.

C. Ecological viticulture is based on stopping the use of organic synthesis substances used to fight diseases and pest, reduce the number of treatments, promote biological means of control, re-introduce traditional substances of control in normal, non-polluting dosages.

This alternative technology belongs to ecological agriculture, which, according to Puia and Soran (1984) is "the system which promotes land cultivation through means capable of maintaining a balance between the agro-ecosystems and the environment, generating specific agro-climates, favourable for the conservation of all the positive elements and processes that form the contemporary and future agricultural systems". The essential characteristics of ecological agriculture are[5]:

- the ecological agricultural system "functions on systemic principles" integrating plant and animal production;
- maintain and regenerate the necessary resources for agricultural production and ensuring a high land fertility as a main means of production;
- harmonize completely the activity and necessity of man's activity and necessity with the life of animals, plants and the soil;
- establish complex ecosystems based on biodiversity;
- knowledge on the biology of plants and of their connection to the environment as a basis for ecological technologies, which comprises classical agrotechnical measures (crop rotation, green cultures, irrigations, mechanizations by agro-biological criteria);
- the choice of varieties that are genetically resistant to diseases and pest, the serious selection of seeding and fruit-bearing material;
- exclude as much as possible, the measures to fight diseases and pest with means external of the ecosystem; that is why the prevention and control of parasites is carried out with the help of natural antagonists.

Abiding by the mentioned characteristics, the technology of ecological viticulture means among others:

- correct placement of wine producing varieties, at a level of homogenous ecological viticultural area in relation to their requirements and the ecological offer;
- attributing to each wine producing variety the priority graft-bearer in relation to its ability to adapt to the soil conditions and affinity of grafting partners;
- plant vines and grass the intervals at the dates indicated by a planetary calendar to better use the cosmic and earth forces;
- crop systems (distances, forms for directions, fruit bear) that valorize the active photosynthetic radiation and simplifies crop technology;
- inoculate composted organic matter that provides nutritional elements and improves the soil's biological quality and integrates it as a living organism in the biosphere's unitary life;
- total exclusion of sythesis chemical products (fertilizers, insectofungicides, herbicides);
- use natural substances that vitalize the soil and plants;
- use specific phyto-sanitary products admitted in ecologic technology when the aggression of pathogen agents is strong;
- direct the vines' metabolism by intervening into their hormonal balance with a natural substance in order to improve the crop quality, improve productivity, tolerance to pest and diseases, and resistance to stress.

Viticultural alternative technologies intend not only to harmonize relations with the environment and human health but also they are important means of increasing economic performance and therefore, **a cost-benefit analysis** is suggestive for an ecological technology proposed to be carried out in the Târnavelor vineyard.

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[5] Gabriel Popescu – Probleme de politică agrară, Publisher ASE, Bucharest, 2001, p.55.

The analysis underlines a few characteristics of ecological technology, as compared to classical technology: expenses with labor force are higher in the ecological option and with decreased mechanical means; expenses with organic fertilizers in the technological alternative and with chemical fertilizers in the classical option; reduced pesticide expenses in the ecological alternative; a higher sale price of ecological products, which compensates for the crop decrease. From the viewpoint of economic performance, the superiority of ecological technology is obvious and it leads to a higher net profit by 216 EURO/ha for grapes and for wine, the additional profit is of 276 EURO/ha.

Bibliographic references:

1.Burja Camelia - Restructurare şi performanţă economică în viticultură şi vinificaţie, Publisher Ceres, Bucharest, 2005.
2. Cămăşoiu Camelia - Economia şi sfidarea naturii, Publisher Economică, Bucharest, 1994, p. 13
1. 3. Davidescu D. Davidescu V. - Agricultura biologică – o variantă pentru exploataţiile mici şi mijlocii. Publisher Ceres, Bucharest, 1994.
4. Filip I. - Posibilităţi de reducere a numărului tratamentelor fitosanitare în plantaţiile viticole, Rev Horticultura nr.6,1986.
5.Intrieri C. Lalalta F. - Viticultura biologică. Aspeti agronomici. Evolutione della tecnica viticola nel nisipetto dell'ambiente. Atti Acad.Ital.Vite e Vino, Viena, vol L1.
6. Iosif, Gh. N. ş.a – Ecomarketingul Societăţilor Comerciale, Tribuna Economică, Bucharest, 1999
7. Papacostea P. Ferma biodinamică, Publisher Ceres, Bucharest, 1994.
8. Puia I. Soran V. – Agroecologie, Tipografia Agronomică, Cluj –Napoca,1984.
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