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"STRATEGIES AND INNOVATION FOR GRAPEVINE INPUTS REDUCTION"

This preliminary report brings together the different international contributions of the wine sector in 2013-Minutes of the Steering Committee Workshop held on October 22-

Tuesday October 22th, 2013
IFV Rooms, 12 Ste Anne Street, Paris

Attendees: Mme Torres Montse, Mrs Palancade J-P., Metral R., Coulon T., Coehlo A. Ferrari G., Rochard J., Debuisson S., Schneider C., Boulay M., Mégnin J-P.

1-Introduction of the workshop: Reminding all that the operation "Reduction of grapevine inputs" was started in 2013 by international consultation, JP. Mégnin indicated that it is the first time that such large operation has been conducted by Vinelink. Questionnaires have been sent to all relevant professions: grape growers, winegrowers, researchers and suppliers have been questioned in ten or so countries and close to 80 answers have been analyzed.
The theme of "inputs reduction" was dealt with during the October 2012 workshop and the March 2013 conference. Two aspects were addressed: influence of plant physiology on diseases evolution (training systems, physiological factors that induce plant resistance, spreading of epidemics, and sustainable management of epidemics and resistance of cultivars) and new equipment and model systems to follow-up such physiology (precision viticulture, sensors for plant vigor, geo-statistic approaches at plot level). Others possibilities still exist to reduce inputs (biological control and use of cultured organism as assistants, modeling epidemics and meteorology follow-up, etc.).
To continue the analysis on strategies to be set to reduce chemical treatments inputs, a selection has been done and six working groups constituted (cultivars improvement, mechanization, experimental networks, plant defense stimulation and bio-control products, economy and communication).
The aims of the October workshop have been to:

- Make a first synthesis of the inquiry that will be concluded in February 2014 and,
- Develop the priority measures that will be presented during the conference in April 2014 at Paris.

2-Inquiry results and first synthesis:

2.1-Mechanization and spraying: The synthesis has been presented by S. Debuisson (CIVC), group leader of this working group.

***First statement*:** In the world, very few people are working on viticulture spraying mechanization while important research is done on major crop cultures. Grapevine represents only 10% of farming equipment, and for this reason it is on major crop equipment that innovations are done and also methodology rolled-out. The heterogeneity of the viticulture stock and its complexity is not suitable to innovations extension when compared to major crop cultivation.
The questionnaire has been sent to 34 experts or professionals, 16 of them have answered. However, there is a good representativeness of the answers for the whole grapevine growing countries, except Spain and Switzerland which have not answered. After analysis, it has also appeared that the questionnaire was not adapted to question grape growers. A better adapted questionnaire will be sent anew.
The absence of answers from questioned manufacturers, except a brief answer from Leers (RAS Marius, South Africa), is also a significant characteristic. One must say at this subject, that the Excel manufacturer group hold 65% of market parts in France and in the world with the numerous companies that it has bought in different countries. Moreover, innovation in mechanization implies big companies having a research unit.
The concern of the working group is to develop an exchange network on grapevine and wine and to put together the world of research and the professional one.

***Countries situation*:** For grapevine, France and USA, but also Switzerland and Spain that have not answered, are among the countries that are doing research on spraying mechanization. France is the only country where a test bench for spraying on artificial grapevine is used (EVAvitispray, IFV/IRSTEA Montpellier).
On their side, Australia and New-Zealand are doing full-scale vineyard tests with different tracers (hydro-sensitive paper, tartrazine compound, etc.). France is also studying the relation product/dose/efficiency in relation to spraying (Work done also in Switzerland). Otherwise, Italy, USA, Australia, New-Zealand and France mentioned studies on spraying techniques domain (Drift measure, drop size, on board electronics). In Italy, sprayers with tunnel effect seem to work well and permit a 33% input decrease of products applied. This equipment is nevertheless of restricted use and limited to grape growers having a high level concerns for adoption of an environmental approach.
As a last point, it is noted Switzerland that has not yet answered, yet is a major performer in the dose/product/spraying adaptation area (Pierre Henri Dubuis, Changins).

***Issues*:** From the survey, a lack of adaption of spraying equipment in relation to vegetation (canopy and leaf type, spraying area, etc.) is highlighted. Tuning is not optimized/maximized for follow-up during vegetation development (need to develop or invent on-board sensors). Work on grapevine is complex with a multitude of forms and situations to be treated (mountain, terraces, plains, etc. narrow and wide rows, different pruning and trellising systems, etc.) and most of the equipment is not adapted to some culture systems such as terraces, vineyards on slope, etc. Some of these grapevine areas are nevertheless of economical importance (this is the case of mountain viticulture in Douro area for example.). Works are about a market of different niches and there is a lack of quantified data on equipment performances. *It is difficult for professionals to make an objective selection of the best equipments with the best tuning while tests done in France demonstrate that there is 1 to 5 differences between equipments in term of product deposits on leaves and bunches (IFV, CIVC).*To give an example, in Champagne, on narrow vineyards, the grape growers use 8 or 9 different spraying techniques.

Asked questions: What are the ways to make limited area demonstrations? In Champagne, for example, there is a tendency to work again on spraying techniques because of a powdery mildew problem in Côte des Blanc's area.

***Methodology*:** The evaluation of spraying efficiency is mainly based on physical measurements around spraying equipment (speed measurement, anemometer, and deposit evaluation on natural or artificial vegetation). In USA and South Africa, the aim is to model drift and product quantities put on the grape. No countries uses a methodology based on interaction between spraying equipment and treatment product, France has begun preliminary trials on such a subject. However, USA (Cornell University) has done tests of disease control type to evaluate the methodology by tartrazine deposits.

***Professional support*:** There is a lot of support for tuning spraying equipment but without novel actions, except traditional communication techniques (meetings, publication in reference magazine, etc.). In Champagne, a survey on spraying (800 responding people) has been done to orientate research on the topic.

***Innovations*:** Methods to collect products by tunnel spraying equipment are cited most often as is the problem and possibilities with spraying robots. Many institutes are waiting for progress in the use on board electronic, associated to vegetation sensors (spraying precision and efficiency). The aim is to better target products, adjust doses; and have more precise application.

***Partnership between equipment manufacturer and companies which market chemical treatment products*:** Except Cornell University, IFV, CIVC and IRSTEA, the obtained answers seem to indicate a lack of R&D work on spraying equipment. In USA, work is mainly focused toward technical development done by manufacturers. For IFV and CIVC, experimentation works are engaged on equipment created by the technical institutes. There is also little relationship between what is occurring on the market and what is done at industrial scale. In other words, innovative and efficient equipment is not always a commercial success because other factors than efficiency that influences the choice like easiness to use and price.

***How to integrate mechanization in an input reduction strategy*?** : Mainly by equipment tuning and different parameters optimization (non measured effects). In France, in the frame of the EVAvitispray program, it is considered to measure the real efficiency of the equipment in term of product deposit on grape foliage.
Spraying equipment functioning is partially dependant on the applied product. Among the phytosanitary industry, only Bayer would have a research laboratory on application techniques (volume of product/ha, dose compared to foliage surface, etc.). Moreover, phytosanitary industry doesn't give any indication on products and their applications.
Nevertheless, the CEB (European regulation standards for experimentation) method for phytosanitary product assessments begins to take in account the mechanization aspect and the seasonal development of the vegetation. The economical aspect of the problem needs also to be taken on now.
Last point; the electronic contribution to mechanization is at the moment mainly to help to reassure grape grower (securing/assurance in application).

***Strategies for reducing risks*:** Limitations of drift and personal safety equipment are the two elements that are systematically considered as priority. The aim is to limit the exposure to chemical treatments by decreasing loss consequences due to spraying equipment.

2.2-Grapevine variety improvement: Presentation by C. Schneider, leader of the working group. The questionnaire has been sent to 14 experts and 13 answers have been received, covering main countries having a research program in term of grapevine improvement. The questionnaire oriented to professionals has been sent to a more limited number of individuals (8) and at the moment 5 answers have been received.

***Countries having developed a grapevine improvement program through sexual crossing*:** Most of the countries are involved in grapevine genetic improvement. In Italy, 3 Institutes work on this topic (Udine University, E. March foundation at S. Michele a. Adige and Milano University). In Germany, the most important program is conducted at Geilweilerhof Institute but a rootstock improvement program is carried out at Geisenheim Institute and selection programs are also developed through regional Institutes (Weinbau Institute at Fribourg). Research done in Germany has conducted to create about twenty resistant varieties (PIWIS). USA and Australia have ongoing programs. In Spain crossings, limited to table grape varieties until now, have been started for grapevine varieties for wine and such research will be also set up for 2014 in South Africa. In Switzerland, apart the Changins Wädenswil Institute, there is a private crossing company Valentin Blattner. In France, it's Inra that develops grapevine improvement programs (varieties for wine and rootstocks) in collaboration with IFV for table grape.

***Beginning of improvement works for wine varieties*:** The oldest works with inter-specific hybrids are from German origin and begin from early 1960. In Switzerland, the programs have started in 1966 and in France, the first works started in 1980s.

***State of progress of the programs*:** Except Germany, resistant varieties issued from inter-specific hybrids have been recently launched on the market. Italy has ongoing the commercial rollout of its new cultivars. In Switzerland, a first variety has been released on the market in 2013. In France (Inra), the first varieties having a resistance from polygenic origin will be presented to national catalogue registration in 2016 (10 applicant varieties, 5 for white cultivars and 5 for black). In Australia, some wine varieties and rootstocks have been released to industry and their evaluations are under progress. In USA, improvement programs are nowadays more oriented to wine varieties, thus among the last 12 registrations, 11 were concerning wine varieties.

***Researched genetic traits*:** Resistance to fungal diseases (Downy and powdery mildews) but also botrytis (Italy, Germany, Switzerland) are the essential targeted characteristic along with the resistance to secondary diseases such as dead arm disease and black rot (Germany). In Australia, adaptation to climatic change is also one of the researched genetic traits (acidity, productivity, resistance to drought, water efficiency). To these entire characteristics one must also add the quality of produced wines, including the one of spirits originated from wines (France, BNIC).

***Resistance type*:** Genetic control of resistances obtained through sexual crossing is not always known. Nevertheless, when a crossing or a back-crossing is issued from only one resistance origin, monogenic resistance can be suspected. At the moment most of the institutes look for polygenic resistances (issues from several genetic resistance sources).

***Upcoming problems during the development of resistant varieties*:** The more advanced institutes in the development of such varieties indicate that wine quality arising from resistant

grapes is acceptable but that there is a problem with the names of the new cultivars which are not known and so, need marketing effort (Germany, USA). Rapid propagation of plant material and appropriation by the winegrowers may be also a problem (IFV France, Italy) same also for the costs to put on the market the new cultivars (CSIRO, USA). These new cultivars are slowly accepted by winegrowers (Italy, CSIRO, USA). Premium wine producers are quite reserved about the possible use of these new cultivars (Italy).

***Scientific problems*:** The ignorance of resistance mechanisms is a problem if one wants to be sure of genes pyramiding. Molecular marker assisted selection is still of limited use (number of identified locis and available markers) which therefore leads to the need to develop such tools (France, Switzerland, Australia, USA) same for the necessity to define minimal chemical treatments and training system to maintain a sustainable resistance to diseases. At this point, a recent paper is cited where the chromosome region of *Muscadinia* ((*Run1*/*Rpv1*) is analyzed. This area corresponds to around ten resistance gene analogs. One of them corresponds to powdery mildew resistance and another to the one to downy mildew. These genes would encode RGP proteins and once reintroduced in a *Vitis vinifera* variety through genetic engineering they are able to give resistance to these two diseases.
One point must be pointed out, sexual crossing conducted to a new variety which is by consequence monoclonal. The standardization risk must be pointed out with the necessity to create a range of crossings for each traditional grape variety.

***Regulation problems*:** In most of the countries, there are no legal barriers to use such new varieties, once registered on national catalogues. The problem only exists for controlled origin labels (Italy, France, and Spain).
Moreover, institutes would consider obtaining plant protection rights with operating licenses.

***Roll-out calendars for these new cultivars*:** From 2013 to 2030 depending upon the country. The delays to put in place the varieties issued from selective improvement programs are around 15 years.
For the questionnaire designed to professionals, they read scientific papers but the small number of received answers shows that work research on resistant varieties are not well known by winegrowers in France while the Swiss works are cited. According to winegrowers, the use of resistant varieties will depend upon the quality of the resulting wines. The producers of premium wines are the more reluctant because they consider the wine quality inadequate in relation with their standards with known varieties. One point is also mentioned by professionals is the risk of standardization of grape varieties, considering the limited number of crossings that will be done for a given variety. Moreover, it is not sure that uncommon varieties will be introduced in crossing programs to improve their resistance to diseases and that will also reduce wine diversity that is offered to consumers.
Among the genetic traits of the resistant varieties that will assist to convince them to use them, wine quality is the first cited and also resistance to some technical dead-ends (ex. Wood decay diseases). A producer deplores that targeted genetic engineering using resistance genes isolated from grapevine genetic background is not possible with well known commercial variety.
Nevertheless, many questioned professionals have still a pioneer role in the resistant varieties trials.

2.3-Experimental networks: The two group leaders (Jacques Wery and Laurent Panigaï) being not available, Raphaël Metral from Jacques Wery laboratory has taken stock of the innovating culture systems that developed in France in the EcoViti network with the

technological support of the UMR System from Montpellier SupAgro/INRA/CIRAD. These systems are set out to give a break in terms of chemical inputs.

ECOVITI program**:** The set up network must mobilize a certain number of drivers for action to monitor grapevine culture system; performance will come from combining interacting culture methods and innovations**.** The national general approach is called ECOVITI and uses a multi-criteria performance evaluation, via systematic experimentation conducted in different agronomical stations.
The ECOVITI program has been set up in 6 French wine areas: Languedoc and Mediterranean arc, South-West, Bordeaux-Aquitaine, Alsace, Loire Valley, and Cognac production area, Charente. The set of experimental sites is engaged in a 6 year program of innovative systems development. According to specific platforms, the developed culture prototypes are different in the technical solution preferences (bio-control, agro-biology, etc.). Around 40 target frames and constraints are conducted to develop around 20 different prototypes that have been tested, calling up different levers (Prophylaxis, new culture systems and bio-control products, resistant cultivars, plowing, genetics, mechanization, etc.). The ECOVITI program has still not included very innovative culture syste*m*s in conceptual terms. At this moment the experimental platforms investigate mainly the efficiency of the different set up levers (treatments).
The first obtained results are promising and diverse; and the ECOVITI network exists. It can and may be used to release innovative cultural practices because of the possible annual readjustment of the tested prototypes. Results will be then transferred from plot scale to farm scale.

Additional project**:** It has been linked to the understudy program: Undertake a technical demonstration through making a scale-up on a guaranteed vintage vineyard (Château Couhins, Pessac-Léognan, Bordeaux area). This trial will be conducted with the progress and feedback loops system in a systematic approach at the farm level. In such approach, the risk management is the main problem to be taken in account (secure grape yield).

2.4-Stimulation of grapevine defenses to control diseases: The group leader X. Daire has apologized and sent a synthesis of the answers to the questionnaire written on this topic. The synthesis is summarized hereafter.
The questionnaire has been sent to 4 experts in representing 3 countries (Germany, 2; Italy, 1; and New-Zealand, 1) and to one manufacturer, in charge of a French SM company (P. Pujos). For French experts, they are gathered in a specific network “resistance induction” (INDRES network) led by X. Daire, so he has summarized the position of French experts. On the 4 contacted experts, 2 have answered (1 German and 1 New Zealander).

State of the art on the induction of resistance through plant defense stimulation products (Summary of the INDRES network)**: *Bion*** (Syngenta), a synthetic compound analog to salicylic acid with a little toxicity, has 50% efficiency against downy mildew when used at high concentration and high frequency (1 application every 10 days). Such combination leads to phytotoxicity, therefore it has little practical interest. Against botrytis, the molecule has 20-30% efficiency with 2 to 3 applications. Trials conducted with ***oligosaccharides*** (products without toxicity) applied with a frequency similar to fungicides have shown 20-30% efficiency against powdery mildew, at least for some of the molecules. The ***Milsana*** (alcoholic extract of plant root) has a regular 50% efficiency against powdery mildew. The product has with no doubt a direct fungicide effect that explains its efficiency but it is not approved in France.

Numerous trials have been conducted with phosphite (phosphorous acid salts) against downy mildew. Such products are elicitors but also known, since the forties years, to be fungicide against downy mildew. It is therefore improper to consider them as Plant Defense Stimulation Products.
The Plant Defense Stimulation Products available nowadays have few practical interests for grape growers. At the moment, association with such products having partial effects (against powdery mildew in particular) with reduced fungicide doses should be evaluated. In USA, it seems that the ***Milsana*** use would permit to reduce fungicide doses against powdery mildew.

***Research proposals*:** Among the points to be studied, one can mention:

- A required progress to be done *on the fine understanding of plant defense mechanisms and how pathogens are able to bypass them*.
- *Research for new molecules.*
- *A better understanding of the factors that influence the plant response to plant defense stimulation products (genotype, developmental stage, mineral nutrition, non-biotic stresses, etc.).*
- *The influence of the pathogen genotype effect and of its epidemiology (pathogen pressure).*

***Particular points pointed out by experts*:** According to the German expert (H. Kassemeyer, Fribourg im Brisgau), plant defense stimulation products should be used in association to fungicides even to strengthen the defense of grapevines partially resistant to diseases. One New Zealander researcher has developed a program against botrytis that combines one agent of biological control (fungus) with the chitosan (an oligosaccharide molecule that have also a fungicide effect).
The French manufacturer (P. Pujos) has also developed a plant defense stimulation product which is a yeast extract (Food complement). He says that there is an important need for experimental designs that will permit a rapid and reliable evaluation of plant defense stimulation product efficiency. For him, research must first bring knowledge on factors that influence plant reaction to pathogens; in contrast, the technical transfer from laboratory to vineyard is of company responsibility, the same as for a conventional plant chemical protection product.
Plant defense stimulation products of adequate and reliable efficiency should be rapidly available on the market for a use as a complement of reduced fungicide doses.

2.5-Professional interventions:

25.1-J-P. Palancade (Agrosud) intervention: Agrosud is a company's gathering that is leader on the Mediterranean arc for plant protection products sales to farmers. The company has tried to apply partially the French national program ECOPHYTO 2018 to work on bio-control products with an experimental team of 3 to 4 persons (Agrosud Development). The limit to apply bio-control products is the level of disease attack. These last years, the pathogens pressure has been generally high in downy and in powdery mildews. It can also be observed that with the intensive use of chemical products, general awareness among the farmers has disappeared. From 2014 to 2016, new bio-control agronomical processes will be proposed to growers, using products having also, among others, a role on plant nutrition and that will go also with prophylaxis methods.
The majors of the phytochemical industry (Syngenta, Bayer, BASF, etc.) will also launch on the market bio-control products, some of them will have also a good efficiency in difficult climatic conditions (i.e. with a high pathogens pressure).

These products will be used in a system where plant nutrition will be well balanced, assuming an intervention at the right time and before the establishment of diseases.

25.2-Mrs M. Torres from Miguel Torres SA intervention: For mechanization, the company works also on small volume spraying equipment (2-3 rows treatment, meaning 4-6 treated sides). Equipments having integrated GPS system have been put in practice in order to take in account plot vigor and give an adequate fertilization to each known plant. Such equipments incorporate on board electronics. Techniques such as sexual confusion (grape berry moth control) are also used to reduce insecticide treatments.
Miguel Torres SA is involved in the European project Innovine (Management INRA, 4 years Kbbe project, 2014-2018). The company coordinates the work package on field trials. There are also others companies involved in the project that work on grapevine improvement. In Penedès, a network working on resistant cultivars (PIWIS) adapted to this Spanish region has been set up. Miguel Torres SA participates in this network but doesn't work on the topic.
Torres Company makes a specific effort on research and protection of old Catalan cultivars, cultivated before phylloxera crisis. To identify and name these cultivars, DNA analysis is used and also classical ampelography, then the plant are propagated and cleaned up through in vitro cultures. Around thirty cultivars have been so propagated and some of them have been included in a blend to elaborate a wine.

2.5-Economy and inputs reduction: The presentation has been given by A. Coelho, one of the leaders of the working group. Answers to the questionnaire (7 asked questions) have been received from Chile, Brazil, South Africa, Portugal, etc. but no one from USA. The main asked questions were the following:

***Main management indexes to take in account at the farm scale losses linked to a certain level of disease (output and others detrimental effects)*:** Very heterogeneous answers have been obtained. Differentiations between inputs (fertilizers versus pesticides) have been suggested and also to counterbalance the required treatments with data relating to organic matter status of each soil type. The proposed indexes have been the "relating output/ha" taken into account each product segments and "Segment-Product" costs. The net cost-effectiveness of the farms (outputs – total production costs, let [(metric tons/ha x grape price) – (expenditure + funds to renew the vineyard)]) is proposed by South Africa.
The main difficulty of these approaches is not taking into account the segmentation of the production processes.

***Economic indexes and estimation of potential benefits linked to input reductions*:** The economic indexes which existed at the level of some farms should be expanded at the level of the production/segmentation pairs.
Others think that this aspect is not relevant considering the high level of mechanization of the vineyard.

***Appreciate economic benefits linked to a viticulture using few inputs*:** The two kinds of viticulture, organic and conventional, have similar profiles. There is no specific index or tool to evaluate economic benefits linked to input decrease and there is no research done on such topic. Nevertheless, one knows that the market asks for products environmentally safe and it is possible to evaluate such benefit. However, no one notices/there is no evidence of a price differential paid by consumer that is consecutive to costs savings through vineyard practices.

***Economic motivations and obstacle to cultivar innovation acceptance*:** Consumer resistance to change is a major obstacle. The central fact is labeling of grape variety wines. In the majority of the markets, consumers respond positively to known grape varieties. Some exceptions do happen but changing grape variety name or use of others names risks decreasing sales to the profit of wine producers that currently use largely known grape varieties.

***What are the good management criteria to renew its vineyard with new grape cultivars?* :** This needs a strategic planning and abilities in financial investments. Inside the EU, criteria are always closely link to interventionist regulation, the others components of the debate having a subordinate role. A partnership approach is also required.

***Risks and eventual costs for a winegrower to change quality and characteristics flavor of its wine*:** Consumers need to understand a consistent story, this may help to overcome challenges linked to resistance to change. Nevertheless, the risk is high, however in a limited number of research works, it has been pointed out that consumers are not able to assess minor flavor changes.

***What are the available indexes to highlight at national level a viticulture input decrease*? :** Market penetration of wineries producing organic or biodynamic wines is one element of environment consideration by consumers but it is a rough index. For wine producers, this consideration is often on a voluntary basis (for example. South Africa with the Integrated Production of Wine or IPW). There is no national index that analyzes and identifies best practices.

***Particular points mentioned during the workshop*:** In France, different types of grape growing farms have been established starting from phytosanitary products use. It has indicated that small size companies are the most important users of such products.
A diagnosis of grape growing farms has also been done on differences between authorised/permitted dose and used dose. It indicates that 40% of the farms are using an excessive dose. For 10% of them, they are high quality grape growing farms, having good economic conditions but with unfavorable climatic ones for grapevine culture.
A survey has also been conducted on herbicides reduction in viticulture, new social standards implying less use of herbicides. There is a strong predilection for a collective dimension in inputs decrease and environmental agreements indicate a large heterogeneity for preferences.
Benchmarking methods have also indicated that without technological change, a 7 to 10% input decrease is possible. If a technological change is happening, the decrease is from 11 to 16%. If the two approaches are combined, one can get up to 30% decrease. For French grape growing farms, it is not therefore possible to reach the 50% objective fixed by the government in the Ecophyto 2018 plan without contribution of innovative techniques.

***Précovision project*:** Since October, 2013, 1st, companies that are distributed phytosanitary products must be qualified. Sales of such products must also be also be accompanied by written recommendations for use.
AgroSud has coordinated a collaborative project (Languedoc-Roussillon Regional Council, Oseo, FEDER and with also Montpellier SupAgro UMR Moisa, ITK, Envilys and IFV) to create a Web tool. The tool is updated on a weekly basis. The aim is to obtain economical data associated to cropping routes.

2.6-Communication: A synthetic presentation has been given by Joël Rochard who is leading this working group.
One must first indicates that France is a particular case in front of phytosanitary products. It is a country where NGO's and Media conduct the most important critique on their use. The Wine and Society association (www.vinetsociete.fr/) prepares a response package on the subject. Communicating on such a topic is therefore difficult.
The working group suggests submitting to a call of a European commission (depending upon the topics included in these calls), a proposal to set up a European exchange network on practices to decrease inputs and consumers information (Web site, specific radio and TV programs, etc.).
J. Rochard and J-P. Mégnin in relation to the subject take stock on Vinelink Web site which is built up in collaboration with computer specialists of Schenk Company and J. Rochard.

3-Points to be discussed and priority measures to be set up:

3.1-Points to be discussed: Two working group Mechanization and Grapevine improvement through sexual crossings have proposed some points of their questionnaire synthesis that need to be discussed.

31.1-Mechanization:

- A questionnaire dedicated to professional and on the expectations they have related to spraying is missing in the survey (It has now been done).
- The fundamental point of biological efficiency in relation to spraying has never been taken into consideration by responding people. It is similar for spraying equipment and decrease inputs strategies.
- The absence of response from manufacturers (after several reminders) shows a lack of involvement from their side in such a strategy, in particular, there is little involvement of European manufacturers in the understanding of the parameters linked to spraying equipment efficiency.
- The economic approach must be undertaken. Robotics and on board electronics are often cited as improvement tools but they go with added costs. The profitability of equipments is in relation with the potential input savings that are to be realized and to grape grower's ability to produce healthy and market-oriented grapes.
- Few answers concern the grape grower's behaviors during spray which are yet a lack of imprecision source as recent communication/extension papers have pointed out (cf. Le Vigneron Champenois, August, 2013).
- The phytosanitary industry is not involved in application techniques (in Bayer Crop Science, three people constitute the application techniques laboratory). This industry doesn't give any information on impacts number and on efficient optimal quantity of product by cm^2 of leaf.
- One question is pending: how to establish a link between spraying and phytosanitary product approvals (CEB methods or others)?
- Equipment assessment tests exist for agricultural sprayers but they are not applied in viticulture. How to adapt these procedures (IHM, IA, etc.) to test viticulture equipments efficiency.
- The Public Authorities show also little involvement in mechanization. The aim would be to define specifications that will be recognized by the Public Authorities to test and assess the equipments that are on the market while manufacturers are against such proposals.

31.2-Grape variety improvement:

- The limited number of professionals suggested increasing the number of *grape growers to be contacted* to have a better knowledge of their acceptance of this new technical proposal.
- The wine quality is essential having as reference the *varieties that grape growers are using at the moment*. Introduction of resistance genes in such varieties will be essential for their agreement to their use.

32.2-Priority measures to be set up:

32.1-Common measure:

- **European network:** A European program should be written on decreasing the input in viticulture. To get a European financing, one must necessarily works in projects oriented towards applied results. DGVI at the EU that runs the risk to lose its research financing, wishes to keep such possibility and needs to be supported.
- A better knowledge of producer networks in each European country should be developed. According to the new European clauses that will issue in December, we will see if our project can be a case of aid.

32.2-Resistance to diseases:

- Powdery and downy mildews have been the first targets but it seems that others resistances must be added if they are not going along with the first ones (Botrytis, secondary diseases such as black-rot, dead arm disease, present technical dead-ends such as wood decay diseases). Getting improved varieties in successive ranges is not very compatible with a perennial species planted for a long time.
- The problem of resistance to some viruses or phytoplasmas is also questioned, same also for an inventory of resistance accessible through sexual crossings.
- The minimal treatment program that will permit to provide sustainable resistance and control of secondary diseases must be ready at the same time that resistant varieties will be put on the market, failing that, such problems will weaken their acceptance by grape growers.
- The effectiveness range of resistance genes in relation to pathogen genetic diversity must be studied again in order to guide maximum resistance sustainability in gene pyramiding.
- Setting-up a European program to design grapevine super genitors (having integrated maximum resistance sources of different origins) is a common desire. They will be used as material source for introducing resistance in a large range of European grapevine varieties (to provide grapevine and wine diversities). It is the same for continuing the work on grapevine genetic engineering, using the resistance genes isolated from grapevine.

32.3-Mechanization:

- Concerning spraying, general public papers have been published and Ecophyto spraying optimizations in viticulture day's work have been hold. The EcophytoPIC site (Agriculture ministry, http://agriculture.gouv.fr/presentation-d-EcophytoPIC) gives a large choice of R&D articles on the input decrease topics with a section on material and equipment. The viticulture aspect has been put on line 3 weeks ago. It would be of interest to make a link between the ministry site and the VineLink Web site.

- It seems that spraying equipment manufacturer's more or less block R&D; manufacturer innovation on the subject being not so much important. *A proactive manufacturer is requested*. For this purpose, the SITEVI catalog gives the list of viticulture equipment manufacturers.
- The Italian tunnel effect sprayers are efficient solutions (33% input decreases) but need to be associated with a high environmental approach.
- Other interesting possibility, *robotics and stand alone equipments* (without tractor driver) driven by GPS: an application has been launched by CIVC.
- One of the priorities is to set-up tests to *compare each other spraying equipments* (see work in progress in IRSTEA/IFV).

32.4-Plant defense stimulation: As soon as 2014, bio-control products will be submitted to practical validation these 3 following years, for an efficacy at 60 to 70% disease pressure average.

32.5-Grapevine variety improvement:

- For extension work, a technical guide-book has been written by ICV (Jacques Rousseau) on the topic, title: Resistant grapevine varieties, March 2013, 212 pages, Group ICV editor, price 49€ plus 7€ shipping costs. A book on resistant cultivar has also been printed in Germany.
- If extension work needs to be done, it is on the vineyard renewal and its dynamics. Assessments done in Hungary in this area could serve as a model to what will occur in France.
- For the extension aspect of these grapevine varieties, if the grape grower enrolls in the process, it is still possible to grow grapevine varieties on a 1 to 2ha basis if they are not yet registered on the national catalog. The surface area has been expanded to several ha for a farm and a wine without geographical indication (GI).
- For extension aspect again, the Aude (French department area) Chamber of Agriculture will put on a web site the existing resistant varieties.
- Other asked question, what roll-out strategy must be considered to slow down the development of resistance to pathogens that could occur with grape variety having inherited just one source of resistance (i.e. to secure resistance genes)?
- A question has been also asked on the possibilities to use environmental financial supports to favor development of diseases resistant varieties, by subsidizing their planting.
- There is an expectation from grape growers about resistant plant cultivars but what about techniques to protect such resistance. Some experimental trials begin on the subject with definition of protocols to minimize secondary diseases (black-tot, dead-arm, etc.).
- Last point, control the risks of standardization and of reduction of grapevine variety diversity supply. There is a need to find relays to develop crossing supplies on a same cultivar and on different cultivars. This has a high cost in term of crossings and later selection, including modern selection techniques (molecular markers and others).

4-Scientific papers and extension papers: Until now around twenty papers have been received that will be submitted to the members of the steering committee for selection. Selected papers will be published each month and then let on the VineLink Web site.

Next committee meeting will be hold at Paris on February, 2014, 13th in order to verify the progress of the selected measures to be taken and to define points to be presented at the April, 2014, 4th conference.

Annexes and supplementary information's

Italy RAUSCEDO (VIVAI Coop Rauscedo, Via Udine, 39, 33095 **Rauscedo** (PN) Italy**):** This coop Works on resistant grapevine varieties and is in Innovine European project..

France: La SCEA Domaine de la Colombette (Ancienne Route de Bédarieux, F34500 Béziers, Tel: 04 67 31 05 53) finances works done in Switzerland and Germany on grapevine variety improvements.

USA: Gallo would continue researches on grapevine genetic transformation to improve grapevine varieties.

Abbreviations:

BNIC: National Inter-professional Office for cognac

CEB: Biological trials Commission**.** It gives standards to perform biological experimentation, including agronomy.

Changins: Agroscope de Changins, Switzerland Institute for Agronomic research**.**

CIRAD: French research Institute for developing countries or International Center for Agronomic Research dedicated to Country Development.

CIVC: Inter-professional Committee for champagne wines

CSIRO: Commonwealth Scientific and Industry Research Organization or Australia's National Science Agency.

ECOPHYTO 2018: French governmental program that planned a 50% pesticides decrease in 2018 for all crops

Exel group: Is a federation of companies (ex. Bertoud, Tecnoma, Kremlin Rexcon, Sames, Hozelock, etc.) which is leading precision spraying techniques and having three markets, agriculture, industry and general public.

FEDER: European Fund for Regional Development

IA: Artificial intelligence

IHM: Man equipment interactions

IFV: French Institute on Grapevine and Wine

Inra: French National Institute for Agronomic Research

IRSTEA: National Institute in Technological Sciences, France

Kbbe project: European research project knowledge based bio-economy

OSEO: Public agency, its assignment being to support innovation and grow of small and medium companies

RAS Marius South Africa: Marketing Director at Rovic Leers (Pty) Ltd Demographic info Cape Town Area, South Africa: Mechanical or Industrial Engineering.

SM: Small and Medium Company

SupAgro: Montpellier University School of Agriculture and Viticulture