

STUDIES UPON THE ECO SYSTEMS FOR THE WEED MANAGEMENT IN VINEYARDS (I)

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Abstract. The paper is dedicate to the vineyard ecological technologies for weed control. Weed composition and quantity were studied in four different country areas. Another important task of our research was the study upon the impact of high temperatures ($> 120\text{ }^{\circ}\text{C}$) on these weeds. The integrate management view is extremely important in vineyard weed control and so, it was developed a technological strategy in this direction. The electro thermal system was adopted for its advantages: high energy efficiency, optimal functional parameters control, etc. In this direction a new machine was developed, in maximum respect for ecological requirements. The machine is a trailed one, considering the working conditions from Romanian vineyards. It is based on the *tractor - PTO - electric generator - electric steam generator - steam distributor ramp* scheme. The machine field tests will be performed next production year, establishing the basic quality and quantity parameters achieved.

Key words: viticulture, ecological weed control, electric steam generator

GENERAL CONSIDERATIONS

Viticulture in one of the most important branch of the Romanian agriculture (5th place in Europe and the 9th place in the world). Our country has one of the oldest wine making traditions in the world, its viticulture dating back about 6,000 years.¹ In the last decade it was a great development in the field compensating the depression period following the events of December '89. After the activity of the "French experts" (natural enemies in wine domain of our country) the introducing of the best technologies in the wine chain Romania has reached the way to improve the quantity and quality of its traditional wines. In these conditions there were developed important vini-viticultural units, one the most important in the *Central-East Europe* being the **Group Jidvei** (with about 2500 ha). This year the unit has produced a bottle of wine for each inhabitant of our country. Consumers increasing demand for organic and sustainably produced products has rise up the interest in organic wine grape (*Vitis vinifera*) production. However, organic production can be challenging, and weed management is a critical issue during the establishment of an organic vineyard.²

Actually, there are two important challenges for viticulture: *the climate changes* and *the digitalization*. The 63rd *International DWV Congress* (Stuttgart 2018) was dedicated to *Viticulture 4.0 – digitalisation across the process chain*. The hot topics ware “*drones and robotics*” as well as the traditional, yet innovative machine.³

Eco wine impose two main requires:

⇒ eco grapes as raw material;

¹History of Romanian wine - <https://premiumromania.com/>

²Deutsche Weinbauverband e.V. (DWV)

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⇒ eco oenology.⁴

The *integrate vine-viticulture system* (fig. 1) put in equation all the influence factors that affect the quality of the final product and the environmental impact as strategy starter. So, digitization can make a decisive improvement to final product quality.⁵

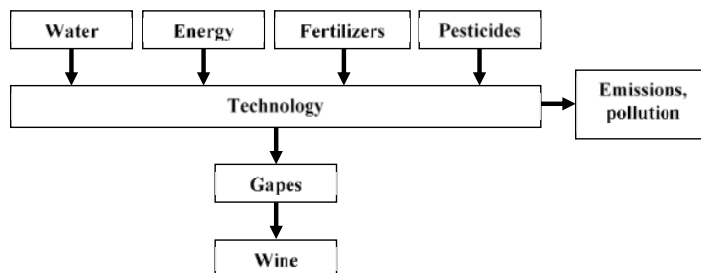


Figure 1. The simplified integrate vine-viticulture system

At the *INTERVITIS INTERFRUCTA HORTITECHNICA* event (Stuttgart, 4-6, November, 2018)⁶ the main aspects of technological culture treatments were explored including the anti-resistance management and handling new pests and diseases. The universal focus was on environmentally friendly, low-cost and time-saving plant protection that satisfies the new requirements resulting from climate change and customer demands for high quality & safe wines. The present paper is dedicated to the ecological weed control in the vineyards. It was made a comparison between the different systems considering their technological and ecological impact. Weed control in vineyard is a very important technological link in the crop chain, as it has a direct and major influence on the amount of water and nutrients available for the main crop. The presence of weeds under the rows is very variable, depending on several factors (soil characteristics, environmental conditions, training system, density of vegetation, etc.) and often the amount of weeds do not justify an herbicide application over the whole field.⁷

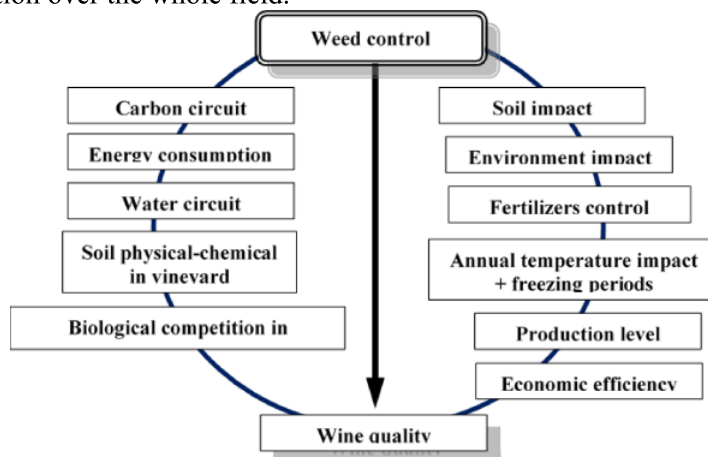


Figure 2. The integrate weed control system

⁴ CBI Product factsheet: Organic Wine in Europe

⁵ Fischer

⁶ <https://www.messe-stuttgart.de/ivifho/en/congress/>

⁷ M. Tamagnone et al. 2013

The vineyard weed control system is a very complex one, cognitive, that should integrate a lot of aspects. In the same time it should be flexible to the different working conditions that can be found in the vineyards. During the studies upon the vineyard weeds, four representative vine regions from Romania were considered: Murfatlar, Valea Calugareasca, Iasi and Tarnave (fig. 3). It was determined the weed stand and spectrum of weeds, the results being presented in table 1.

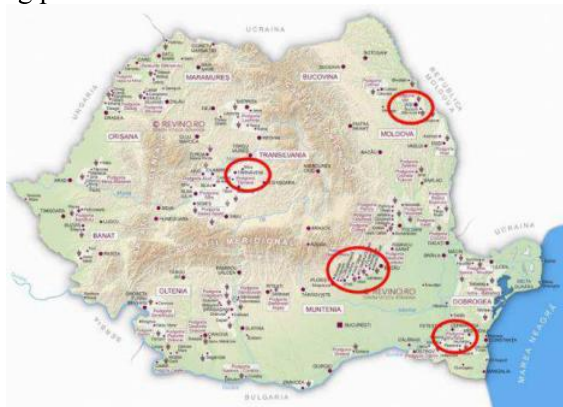


Figure 3. Areas for vineyard control weeds analysed

Table 1

Weed infestation degree in studied vineyards areas

Weed species	Infestation degree %		
	Fetească neagră	Chardonnay	Cabernet Sauvignon
Monocotyledons			
<i>Sorghum halepense</i>	5	4	7
<i>Agropyrum repens</i>	-	2	3
<i>Cynodon dactylon</i>	6	-	-
<i>Digitalia sanguinalis</i>	2	-	-
<i>Poa anua</i>	2	-	-
<i>Poa pratensis</i>	-	0,2	0,4
<i>Cynodon dactylon</i>	-	6	5
<i>Setaria viridis</i>	2	5	6
<i>Echinochloa crus-galli</i>	5	-	-
Dicotyledons			
<i>Convolvurus arvensis</i>	15	5	6
<i>Galium aparine</i>	3		
<i>Amaranthus retroflexus</i>	26	19	29
<i>Amarantus chlorostschys</i>		8	12
<i>Amarantus albus</i>		2	3
<i>Taraxacum officinale</i>	3	8	3
<i>Sonchus oleraceus</i>	3	0,4	0,3
<i>Chenopodium album</i>	8	5	15
<i>Urtica urens</i>	3		
<i>Tribulus terestri</i>	2		
<i>Polygonum aviculare</i>	3	5	5
<i>Lalium aplexicaule</i>	3		
<i>Portulaca oleracea</i>	9	15	20
<i>Digitalaria sanguinalis</i>	-	10	0,6
<i>Lepidium draba (</i>		3	1
<i>Capsellabursapastoris</i>	-	15	10
<i>Solanum nigrum</i>		0,5	0,8

Ecosystems for weed control

In figure 4 there are presented the main ecological systems that can be used for weed control in vineyards. All of them were tested by several research teams, in time being discovered their positive and negative impact on the technology efficiency and on the environmental impact. The proposed vineyard weed control system was developed focus on respect of the highest environmental requirements and biodiversity conservation (see in fig. 5 the system development phases). The system is based on the previous experiences and on the new technological demands. Considering the it was adopted the dual weed control system (fig. 6): one interval with mechanical control and the next one with steam (thermal) control, changing between them each 2-3 years.

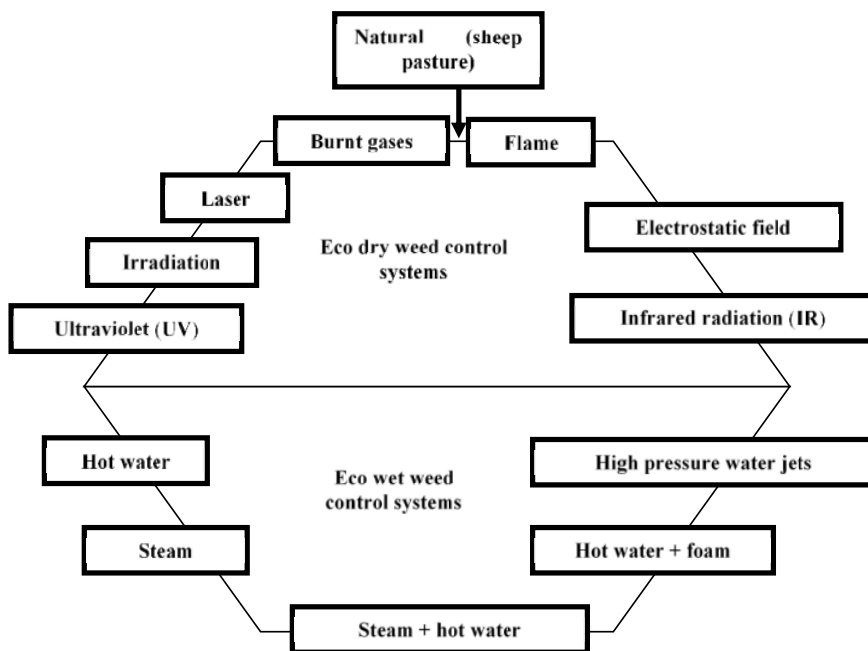


Figure 4. The eco systems for the weed management in vineyards

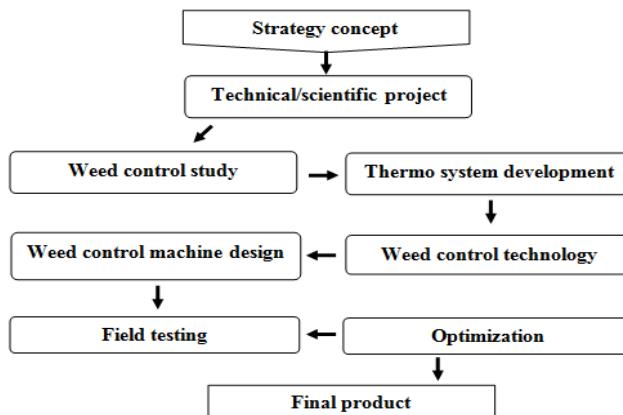


Figure 5. The development scheme of the vineyard weed control system

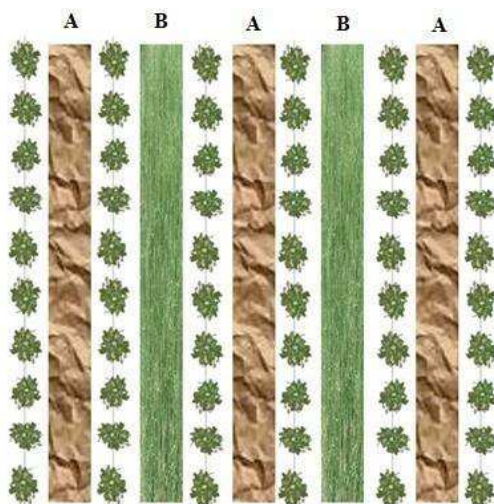


Figure 6. Technological system for weed control
 A - mechanical control; B - steam (thermal) control

The electro thermal system was adopted for its advantages: high energy efficiency, optimal functional parameters control, secure safety system, etc. In this direction a new machine was developed, in maximum respect for ecological requirements. The machine is a trailed one, considering the working conditions from Romanian vineyards. It is based on the *tractor - PTO - electric generator - electric steam generator - steam distributor ramp* scheme (fig. 7). The tractor power required is above 75 HP.

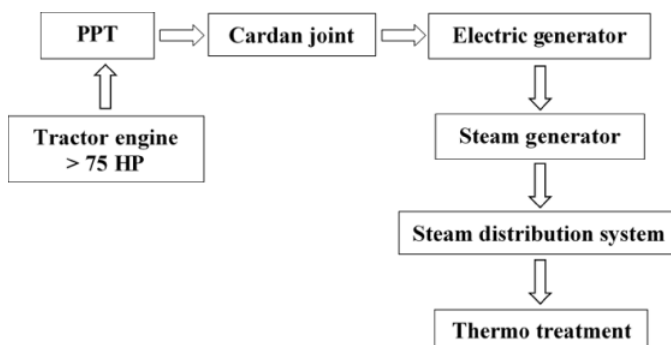


Figure 7. The general scheme of the thermo weed control machine

The mechanical energy provided by the vineyard tractor is transmitted to the electric generator that supply the necessary energy the steam generator:

$$W_t = 1/\eta_S \cdot (W_m + W_{ge} + W_{ga})$$

where:

W_t is the total energy induced in the system;

W_m - mechanical energy introduced in the system;

W_{ge} - electric energy produced by the electric generator;

W_{ga} - thermal energy produced by the steam generator;

η_s - system total efficiency (mechanical efficiency x electrical efficiency);

To increase the treatment efficiency the steam nozzles were distributed on two rows (fig. 8). The superior and lateral parts of the steam distribution ramp are covered with a steel shield in order to direct the steam only to the focus treatment area.

The boiler (55 l) is a 12 mm thickness steel container one.

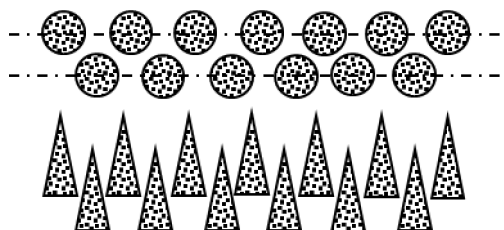


Figure 8. Two rows placement of the steam distribution nozzles

CONCLUSIONS

The main conclusions of our study are:

1. Introducing ecological weed control systems in vineyards is compulsory for the eco premium wines.
2. Steam weed control in vineyards is an important and efficient option for weed control.
3. In the same time, steam weed control offers the possibility of the hygienisation of the intervals areas.
4. A short and long term weed control strategy is compulsory for a rationale technology development.

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