LIFE Project Number

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Deliverable "Swot Analysis"

Sub-action B2.4 "SWOT Analysis"

LIFE+ PROJECT Soil4Wine

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1. Introduction: Project overview

Soil4Wine project "*Innovative approach to soil management in viticultural landscape*" is aims to achieve a better soil management in the whole viticultural system developing and testing an innovative Decision tool and management solution tested in farm in Project area and Europe.

This report presents the structure and main outcomes of sub-action B2.4 related to Soil4Wine project Action B.2 "Demonstration in vineyards" from M1 (01.01.2017) until M22 (30.10.2018). HORTA is the responsible for this action and UCSC is the other partner involved

2. Material and Methods

2.1 Data collection

Data collection for assessing strengths, weaknesses, opportunities and threats rising from using the Decision tool and from solution implementation was launched as foreseen in the first project year. In particular, first feedbacks from Demo farmers on α- tool were collected during the co-development meeting (M8:01/08/2017 at Res Uvae) and, considering the nature of the α-tool itself (i.e., not yet user-friendly – excel file) it was decided to collect feedbacks on the usefulness and expectation, rather than on the clarity and user-friendliness, via oral questionnaire. Details were provided in Deliverable B3.1 in which all the activities and discussions held during the co-development meetings are described.

A sampling plan was developed to collect soil and plant parameters (foreseen in the proposal) in the demonstration vineyards: soil samples were collected in M10 and physical/chemical analysis was externalized to a specific laboratory; vine behavior parameters were collected during harvest (M8-M9 and M20-21) and pruning (M11-M12). Weather stations and soil temperature and humidity were installed in M12 and real-data data collection has started. In spring 2018 floristic surveys was performed to complete the first year data collection, as well as data on environmental impacts of the different management solutions were calculated through the DSS "vite.net" on the grape growing season 2018.

All the results obtained during the sampling plan were aggregated according the different type of innovation tested in the demo farms. In particular, three groups were created:

- Spontaneous grassing vs permanent cover crops: this group was composed by the demo farms SP1, SP4 and TBC1 (TBC2 will be considered for the 2nd evaluation round since the cover crops sowing was performed in October 2018);
- Tillage vs green manure: this group was composed by the demo farm SP2;
- Spontaneous grassing vs green manure: this group was composed by the demo farms SP3, VT1 and VT2.

In the demo-farm RES116 another case study was considered: the adoption of underground pipe drains to be installed along the inter-rows of critical situations/vineyards. In particular, drains were installed in May 2018. The drains were installed under both soil tillage and grass soil conditions in order to be compared with the standard soil management practice of the farm (i.e. alternate rows tillage and spontaneous grassing). The evaluation of soil erosion was visually performed at the end of the growing season using the assessment scale presented in Table 1.

Table 1 – Assessment scale for visual evaluation of soil erosion in vineyard. The scale was used to evaluate the effect of pipe drains used in the demo-farm RES116 as innovative technique for soil management.

				
	Absence (0-5%)	**Low (5-25%)**	**Medium (25-50%)**	**High (>50%)**
Erosion evidences	Presence of erosion is not evident	Little evidence of erosion	Evident soil erosion	Severe evidences of soil erosion
Soil grooves depth	Only little difference between soil level in the row and inter-row	< 5 cm	5-10 cm	> 10 cm
Vine roots	Not visible at all	Not visible	Roots partially visible	Roots clearly exposed
Grassing (if present)	Homogeneous grassing	Grassing not uniform	Stunted grassing	Heavy stunting of the grassing

2.2 SWOT Analysis

SWOT analyses derive their name from the assessment of the Strengths (S), Weaknesses (W), Opportunities (O), and Threats (T) faced by an industry, sector, company or any organisation (Gao and Peng, 2011). The idea of a SWOT analysis has its roots in strategic management research conducted in the 1960s and 1970s (Sevkli et al., 2012), and arises from the perspective that the performance of a given (typically, but not only, economic) agent with respect to a particular objective depends upon the way in which the management of that agent interacts with both the internal characteristics of the agent, and the broader external context in which the agent must act (but over which the agent has no direct control in the short term) (Houben et al., 1999).

The value of a SWOT analysis stems not only from its ability to highlight ways in which an agent's internal and external environments interact to affect its success (Houben et al., 1999), but also from its ability to be used in the development and implementation of long-term strategies to achieve particular objectives (Houben et al., 1999; Gao and Peng, 2011; Sevkli et al., 2012). There are various classes of strategies that can follow from a SWOT analysis: e.g. those that link Strengths and Opportunities ('SO Strategies'), those that link Weaknesses and Opportunities ('WO Strategies'), those that jointly focus on the Strengths and Threats ('ST strategies'), and those that arise from the joint assessment of Weaknesses and Threats ('WT Strategies'). For example, SO strategies utilise the fact that Strengths may help to capitalise upon external Opportunities, whereas WO strategies focus upon the pursuit of external Opportunities to lessen the severity of Weaknesses. Similarly, ST strategies focus on the potential for existing internal Strengths to mitigate the impact of external Threats, while WT strategies consist of actions intended to reduce both internal Weaknesses and external Threats simultaneously (Sevkli et al., 2012).

A specific questionnaire was prepared and presented to the demo farmers involved into the project in order to classify the pros and cons of each of the innovative solutions tested.

3. Results of the 1st round analysis

The main results obtained are reported in Table 2, where are presented the averaged results of some agronomical indicators (i.e. yield, sugar content, vine fertility etc.) and some environmental indicators (i.e. carbon, water and ecological footprints and carbon sequestration) which were calculated using vite.net® in the different demo-vineyards. The yield obtained with the standard management techniques ranged from 7,1 t/ha (soil tillage) to 17,9 t/ha (spontaneous grassing) while with the innovative techniques ranged from 10,8 t/ha to 17,6 t/ha (both green manure). The minimum sugar content was 20,3° Brix, observed in the spontaneous grassing plot, while the maximum was 22,7° Brix, observed in the green manure plot. The average weight of bunches ranged from 84 gr (soil tillage) to 289 gr (spontaneous grassing) while vines fertility ranged from 1.08 to 2.33 (both green manure techniques; Table 2). The carbon footprint ranged from 0,090 to 0,116 t CO2 eq/t/ha in the innovative management with permanent cover crops and the standard practice of soil tillage, respectively. The water footprint indicator ranged from 889 to 1526 m^3 H2O/t/ha in both cases under the condition of spontaneous grassing (Table 2).

The results obtained with the innovative management techniques were compared with the standard ones for each of the three groups and the main variations are reported in Figure 1. Results obtained in the case study of pipe drains are presented in Table 3, while in Figure 2 the main variations caused by the adoption of the innovative technique are shown.

3.1 Vines and environmental data

Spontaneous grassing vs Permanent cover crops

The implementation of permanent cover crops as innovative soil management technique led to an increase of 20% in yield, compared to spontaneous grassing. The innovative solution produced also positive variations in terms of carbon sequestration, ecological and carbon footprint. The average bunch weight of the innovative solution increased by 20%, compared to the standard: this aspect may be more or less positive depending on the specific susceptibility to bunch rot of the grapes variety (i.e. heavier bunches tend to be more compact, with a thinner skin and are more exposed to rot risk). In the plots managed with the innovative solution a reduction in the sugar content was registered, that is nowadays generally considered a positive result.

Tillage vs Green manure

The adoption of green manure (innovative soil management technique) led to an increase of about 50% in yield compared to the most standard practice of soil tillage. As shown in Figure 1, the green manure brought to very positive results in terms of carbon sequestration increase (+50%), reduction of ecological (> -30%), water and carbon footprints (approx.- 20%) compared to the standard practice. The average bunch weight of the innovative solution heavily increased (+60%) compared to the standard. A slight increase in vine fertility was registered in the plot with the innovative solution while no appreciable variation in terms of sugar content in the grape juice was observed.

Spontaneous grassing vs Green manure

The green manure led to a slightly higher yield than the standard soil management technique, spontaneous grassing. On average, the plots managed with the innovative technique registered a less favorable carbon footprint than the conventional practice. The water and ecological footprints of the innovative plots resulted to be slightly higher. In the vineyard managed with green manure also average bunch weight, vine fertility and sugar resulted to be higher compared to the standard grassing with spontaneous species.

Application of pipe drains

The drains were applied after the grapevine bud-break (May 2018) so the effect during the first year cannot be fully evaluated. Also because the soil preparation and the drains application caused a mechanical stress to the soil that should necessarily recovered before the innovation can be effectively evaluated. All these considered, during the first season a certain reduction of yield, fertility and sugar content was observed in the innovative plot, even if there was no statistical difference with the standard practice. The erosion was visually evaluated according to an assessment scale (Table 1) at the end of the growing season in each row of both innovative and standard technique, and the effect of drains was able to reduce the negative effects on soil of about 10% compared to the traditional practice.

Table 2 – Main indicators considered for the different innovation tested: data represent the average of the results obtained in each experimental farm, grouped according the innovation tested, for both standard and innovative soil management technique.

Description		**Std**: spontaneous grassing **Inn**: permanent cover crops	**Std**: tillage **Inn**: green manure	**Std**: spontaneous grassing **Inn**: green manure
Experimental vineyards (code)		SP1 - SP4 - TBC1	SP2	SP3 - VT1 - VT2
Yield (t/ha)	Standard	13.6	7.1	17.9
	Innovative	16.9	10.8	17.6
Carbon footprint (t CO2 eq/t/ha)	Standard	0.100	0.116	0.093
	Innovative	0.090	0.097	0.112
Water footprint (m3 H2O/t/ha)	Standard	1526	1198	889
	Innovative	1187	908	893
Ecological footprint (global ha/t/ha)	Standard	0.234	0.384	0.164
	Innovative	0.180	0.258	0.170
Carbon sequestration (t C/ha)	Standard	3.5	1.9	4.1
	Innovative	4.2	2.8	4.2
Avg. bunch weight (kg)	Standard	0.166	0.084	0.289
	Innovative	0.200	0.137	0.281
Vine fertility	Standard	1.76	2.17	1.12
	Innovative	1.79	2.33	1.08
Sugar content (°Brix)	Standard	22.5	22.6	20.3
	Innovative	21.4	22.7	21.2

Table 3 – Main indicators considered for the innovation management based on the use of pipe drains. In the DSS vite.net® a specific function for considering the effect of pipe drains onto environmental indicators is under development: it will be possible to re-calculate the effect of drains also for the first season once this function is fully implemented.

Description		**Std**: no drains **Inn**: pipe drains
Experimental vineyards (code)		RES116
Yield (t/ha)	Standard	25.1
	Innovative	17.1
Avg. bunch weight (kg)	Standard	0.304
	Innovative	0.253
Vine fertility	Standard	1.15

	Innovative	0.92
Sugar content (°Brix)	Standard	22.8
	Innovative	22.4
Erosion (visual assessment score%)	Standard	6.1
	Innovative	5.5

Figure 1 – SWOT analysis of different standard managements (i.e. spontaneous grassing and tillage) compared to innovative solutions (i.e. permanent cover crops and green manure). Output about vines data, environmental indexes and questionnaire submitted to the demo farmers are expressed as a proportion of the variation of each innovative solutions compared to the standard.

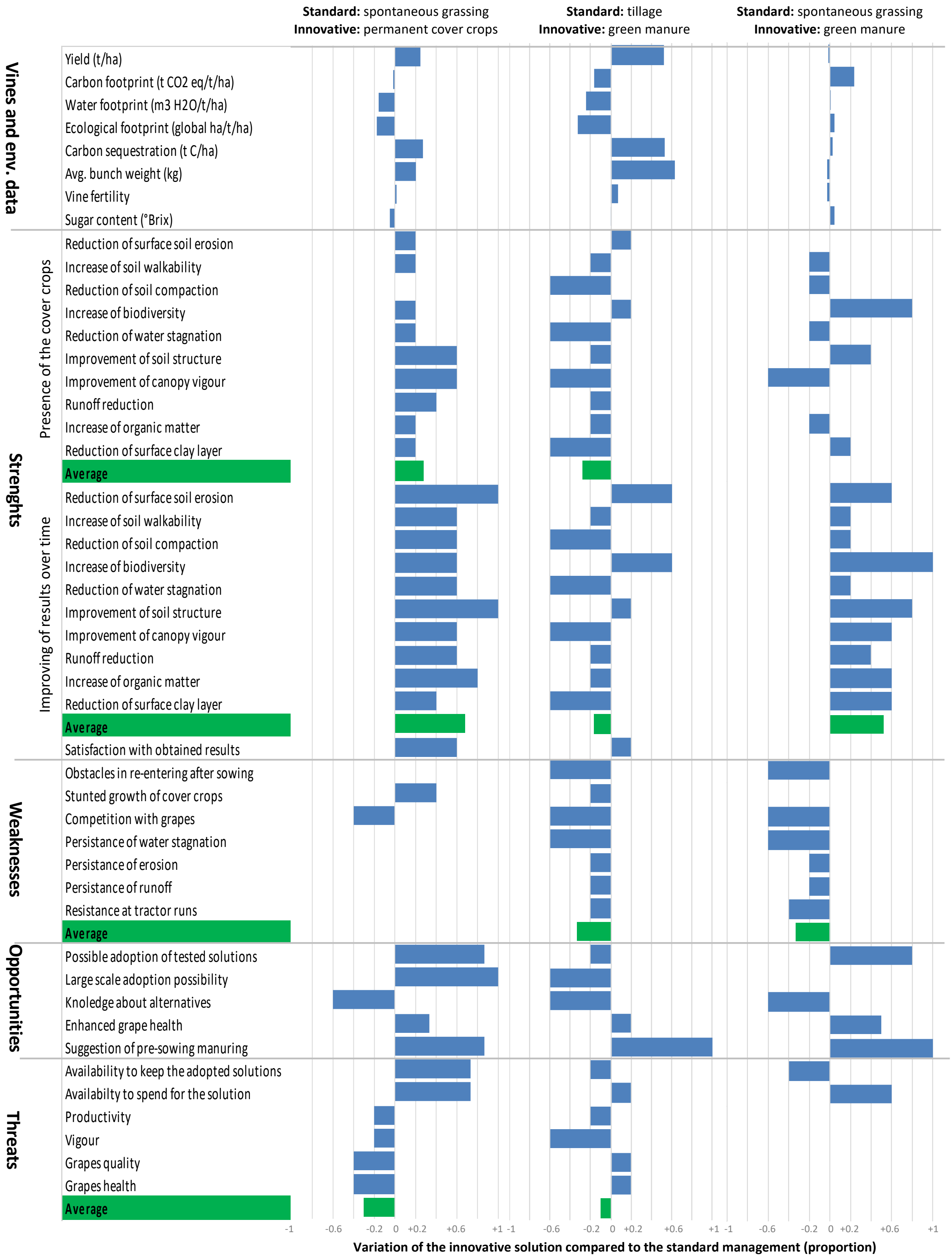

Figure 2 – SWOT analysis about the application of an innovative technique (i.e. pipe drains) instead of the standard management in the demo-farm Res Uvae (RES116). Output about vines data, environmental indexes and questionnaire submitted to the demo farmers are expressed as a proportion of the variation of each innovative solutions compared to the standard.

3.2 Strengths

<u>*Spontaneous grassing vs Permanent cover crops*</u>

According to the demo-farmers adopting permanent cover crops as innovative solution, compared to spontaneous grassing, it allowed to improve the soil structure (+60%), the vigor of the canopy (+60%) and to reduce the runoff (+40%). The innovative solution tested was able to decrease the surface soil erosion, the water stagnation and the formation of surface clay layer, while it participated to increase the soil walkability, the biodiversity and the organic matter. All these factors were scored as +20% in the demo-farmers opinion. Overall, demo-farmers are very satisfied with the obtained results for both the presence of the cover crops and the improvement of results expected over time, ranking the strengths of the innovative techniques, on average, almost of + 70% compared to the traditional technique.

Tillage vs Green manure

According to the demo-farmer adopting green manure compared to tillage, the innovative management solution led to a positive variation only in terms of reduction of the surface soil erosion (+20%) and increase of biodiversity (+20%). Overall, the demo-farmer was not completely satisfied with the results obtained with the green manure compared to tillage after the first cropping season and he is looking forward the evaluation of mid-term period results over the second year.

Spontaneous grassing vs Green manure

As shown in Figure 1, increase in biodiversity, improvement of soil structure, reduction of surface clay layer and reduction of water stagnation were the most positives factors which, according to demo-farmers, were improved by the application of the innovative technique compared to the standard practice. Conversely, the green manure led to a reduction of soil walkability, soil compaction, organic matter and canopy vigor. According to demo-farmers, adopting green manure as innovative soil management technique over time will lead to an increase of all the indicators, with particular regard to biodiversity and soil structure. Despite the scores given to the innovative technique the demo-farmers, on average, expressed the same satisfaction of the results as the standard practice.

Application of pipe drains

The presence of underground pipe drains was evaluated very positively by the farmer: in particular, it was considered strongly effective (+100% compared to the standard practice) in the reduction of runoff and surface soil erosion, visibly effective in reducing soil compaction (+60%) and also able to limit water stagnation (+20%) compared to the standard practice. Also the improvement of the results over time is very well considered by the demo-farmer, even if in this case the presence of the pipe drains limit the activities (i.e. deep soil tillage) that can be applied to the vineyard. On average, the farmer considered strongly positively the presence of pipe drains (+70%), he is extremely satisfied with the results obtained (+100%) and he is also optimistic for the improvement of results over time (+30%).

3.3 Weaknesses

Spontaneous grassing vs Permanent cover crops

The permanent cover crop resulted not to be an obstacle in reentering in the field for agronomical operations after sowing. Nevertheless the cover crops presented a stunted growth and it was the main weakness according to demo-farmers. Less competition with grapes was perceived in the plots with permanent cover crops compared to the spontaneous grassing.

Tillage vs Green manure

As regards the potential weaknesses in Figure 1, the less negatively perceived by the demo-farmers were the obstacle in reentering after sowing, the competition with grapes and the persistence of water stagnation. Overall, the considered weaknesses were not seen negatively, meaning that the innovative solution had positive effects on the resistance on tractor runs, decreasing of runoff, erosion, water stagnation and that the growth of cover crops was fine. The green manure resulted not to be an obstacle in returning into the field for agronomical operations after sowing.

Spontaneous grassing vs Green manure

As expected, the demo-farmers implementing green manure vs spontaneous grassing gave answers very similar to the farmer implementing green manure vs tillage. The resistance of tractor runs was perceived by this group of demo-farmers as less problematic. Green manure resulted not to be an obstacle in returning into the field for agronomical operations after its sowing.

Application of pipe drains

The most relevant weaknesses of this system for the demo-farmer were related to the reduction of productivity, grape quality and vine vigour mainly due to the installation of the pipe drains, on average -47% compared to the standard practice. These weaknesses were only partially confirmed by the yield reduction observed for the first year after the installation, because for instance the sugar content was the same in both the innovative and standard plots.

3.4 Opportunities

Permanent cover crops and green manure, compared to spontaneous grassing, scored very high rates on the possible future adoption without the help of the researchers involved in the Project (>80%), while the demo-farmer used to tillage is slightly negative as regards the possible adoption of green manure in the future. The group of demo-farmers which is more positive about the possibility of a large scale adoption of the innovative solution is the one who implemented permanent cover crops. Grape health is largely perceived by demo-farmers as an opportunity linked to the adoption of innovative solutions. All the farmers unanimously proposed a pre-sowing manuring for the cover crop in order to improve its growth.

The demo-farmer who tested the pipe drains largely considered them a good mitigation solution (+22%) and he was very optimistic about the possibility to adopt them on a large scale (+60%).

3.5 Threats

The main threat perceived by the farmers implementing permanent cover crops as innovative solution was about their availability to keep the adopted solution over time and to spend money specifically for it (i.e. buying machineries or paying for external service) compared to the standard management. Permanent cover crops are not perceived as a threat in terms of productivity, vigor, sanity and quality of grapes. The demo-farmer testing green manure instead of tillage, considers its availability to spend for the solution the major threat to adopt the innovative technique along with a reduction in both sanity and quality of grapes due to the presence of the cover crops. Moreover, the group of farmers adopting green manure vs spontaneous grassing is not threaten to maintain the cover crops over time, but is highly discouraged by the idea of spending money for the adoption of the innovative technique. Finally, the demo farmer that was testing the application of pipe drains was considerably available to spend money for the innovative solution both in terms of advantages derived from it and for future replacement costs.

4. Conclusions

The innovative soil management technique which gave the most positive result in terms of yield, carbon sequestration, ecological, water and carbon footprints is the adoption of green manure. For the same technique also the average bunch weight and vine fertility variations resulted to be higher so it can be discussed its adoption on the basis of the oenological target of grapevine production.

Overall, demo-farmers believe that the positive effects produced by the innovative solutions should increase over time: in particular, improvement of soil structure, increase of biodiversity and reduction of surface soil erosion are the descriptors for which the most positive variations are expected in the future. Concluding, demo-farmers results to be quite satisfied of the results of the innovative solution compared to the standard ones after one complete season of activities.

5. References

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