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"The Carbon Footprint in a red wine production of Southern Italy's vineyard"

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Introduction

The vineyard system could contribute to the sequestration of atmospheric carbon through the recycling of crop residues, the introduction of a grass strip that increases the photosynthetic surface, enriching the soil with organic-C and reducing the erosion and its possible consequences. In addition, the compost distribution in place of chemical fertilizer inputs, should substantially increase soil carbon inputs.

Objectives

To calculate and to compare the CF of two vineyard systems: conventional and sustainable. We choose to added field phase in the calculation data survey.

Research Scenario and Measurements

Vineyard:	Aglianico/1103 Paulsen, 5 years (Photo 1) Cordon spur (4400 plants ha^{-1})
Soil:	Chromi-Luvic Kastanozems (SSS, 1998)
Soil management:	Conventional: soil tillage, chemical fertilization Sustainable: spontaneous cover crops, compost distribution (15 t $ha^{-1}y^{-1}$), re-use of material pruning,
Technical measurements:	Total soil respiration efflux with fixed soil chambers (3 years)

CF determination

For the cultivation phase, the average number and duration of individual operations were recorded and the emissions were related to energy consumption involved in the performance of single and specific activities. Irrigation emissions was considered. Emissions were calculated similarly in all the stages (winery, packaging and distribution) that by using the conversion coefficients found in the literature.

The CO_2 emissions from soil were daily measured in the sustainable block during three growing seasons, using eight cylindrical soil chambers connected to an infrared CO_2 detector (Photo 2). The daily data were integrated and then added together to calculate the annual emissions of CO_2. The human labour has been considered as energy input into the production cycle .

For the energy involved in various processes (MJ), a conversion factor 0.1431 (0.278×0.531) was used to determine the corresponding quantity (kg) of CO_2 equivalent (emission factor for Italian electricity distribution mix - www.miniambiente.it).

Photo 1. Experimental vineyard.

Photo 2. System of total soil respiration measurements.

The CF (kg of carbon released into the atmosphere per bottle) was determined by computing individual values of C emitted and sequestered, related to the phases. Emissions of distribution phase were considered on hectare average production (9500 bottles, from 0.75 L each) which was transported by road to Germany (1200 km).

Results and Discussion

Grape production was 9.6±1.5 t ha^{-1} of fresh product corresponding to 2.9 t ha^{-1} of SS. (Table 1). Overall, the biomass (dry matter) produced annually in sustainable vineyard was 14.1 t ha^{-1} and was approximately 6.9 t ha^{-1} in the conventional theory. These differences are largely attributable to grass cover.

Table 1. Field natural phase	CONVENTIONAL		SUSTAINABLE	
	t ha^{-1} D.M.	Carbon t ha^{-1}	t ha^{-1} D.M.	Carbon t ha^{-1}
Pruning material	0,91	0,52	0,91	0,52
Grass cover	0,81	0,33	8,13	3,31
Trimming residuals	0,41	0,17	0,41	0,17
Berry cluster	2,93	1,33	2,93	1,33
Roots + wood *	1,39	0,75	1,39	0,75
Compost	-	-	10,90	4,86
Leaves	0,47	0,20	0,47	0,20
TOT	**6,92**	**3,30**	**25,14**	**11,14**

Winery, packaging and distribution phases were calculated assuming a production of 9500 bottles of 0.75 L. Moreover, the amount of CO_2 emitted during alcoholic and malolactic fermentation made by microorganisms was also considered. It turned out that about 60%.

Table 2. Total emissions		CONVENTIONAL		SUSTAINABLE	
		Carbon t ha^{-1}	% Emissions	Carbon t ha^{-1}	% Emissions
FIELD	Soil emissions	7,28	53,26	11,50	66,4
	Biomass + Compost*	-3,30	---	-11,14	---
	Materials & vehicles	2,17	15,87	1,60	9,24
Winery		0,35	2,56	0,35	2,02
Packaging		2,72	19,90	2,72	15,70
Distribution		1,15	8,41	1,15	1,15
	Total	**10,37**		**6,18**	
	C.F. (%)	1,00		0,59	
	C.F. (kg C per bottle.)	**1,09**		**0.65**	

In packaging phase, the value of emissions associated with the "glass" represent the 80% of these phase. We summarized the emissions and removals of C calculated in various stages of the production process (Table 2). It was found that the cultivation phase represents about 70% of total emissions in both theses. Consequently, considering field phase and especially C inputs in the vineyard system, there was a containment of 41% of carbon footprint in sustainable thesis (0.65 kg C per bottle) than conventional. Clearly, the formation of a larger amount of biomass (eg grass cover) may thus contribute to the reduction of CF.

Conclusions

This work demonstrates that a sustainable management (adding compost and grass cover) can be a powerful tool for reducing the CF in fruit orchards and contributes to store carbon in soil. This paper reports the preliminary results of ongoing research, giving some information on the C effluxes at field level of cultivation necessary for a more accurate calculation of the CF.

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