THE COMPARISON OF ORGANIC, BIODYNAMIC AND CONVENTIONAL FARMING IN PINOT BLANC AND RHINE RIESLING IN THE 2016 VINTAGE YEAR

COMPARACIÓN DE LA GESTIÓN CONVENCIONAL, BIOLÓGICA Y BIODINÁMICA DE PINOT BLANC Y RIESLING RENANO DE LA VENDIMIA 2016

NICOLINI, Giorgio[1*]; ZANZOTTI, Roberto[1]; BERTOLDI, Daniela[1]; ROMÁN, Tomás[1]; MALACARNE, Mario[1]; PELLINI, Melissa[2]; MESCALCHIN, Enzo[1]

[1]Fondazione Edmund Mach (FEM), via Mach 1, 38010 San Michele all'Adige, Italy.
[2]UC Davis, Viticulture and Enology, 1 Shields Ave, Davis, CA 95616.

*** Corresponding author**: enzo.mescalchin@fmach.it

Abstract

This study reports results concerning the comparison of conventional, organic and biodynamic farming in a Pinot blanc and Rhine Riesling vineyard in Northern Italy. The experiment started in fall 2011, and is still ongoing. The aim of the study is to evaluate the influence of the farming systems on soil, vegetative-productive characteristics of the vines, and quali-quantitative parameters on the grapes and wines obtained following the conventional, organic and biodynamic production rules. The vineyard under observation is ≈ 1.5 ha in size, and was planted in 2009. The vines are trellised simple pergola with 2.80 x 0.50 m plant spacing. Each variety has two clone replicates with parcels of over 1000 m2 each, allowing for buffer areas to avoid drift issues. After 7 years of testing, the 2016 data shows superior yields with the biodynamic parcels in both varieties. This difference was significant between the conventional and biodynamic farming systems. No additional external organic matter was introduced to the biodynamic plots except an annual green manure on alternating rows that was subsequently mowed approximately in mid May. The yeast assimilable nitrogen (YAN) levels were lower in organic farming parcels, while not showing significant differences in the other two treatments.

Keywords: Farming systems, organic, biodynamic, grape composition, yeast assimilable nitrogen (YAN)**.**

Resumen

El estudio reporta los resultados relativos a la comparación de la gestión convencional, biológica y biodinámica en un viñedo de Pinot Blanc y Riesling Renano. La comparación inició en el otoño de 2011 y está aún en marcha. El objetivo del estudio consiste en la evaluación de la influencia de la gestión del terreno sobre las características vegetativo-productivas de las vides y de los aspectos cuantitativos y cualitativos de las uvas y de los vinos obtenidos según las normativas de producción convencional, biológica y biodinámica. La prueba se está realizando en un viñedo de ≈ 1,5 ha, plantado en 2009, con pérgola simple como sistema de conducción y con un marco de plantación de 2,8 x 0,5 m. Cada una de las variedades comprende dos clones y las diferentes gestiones del suelo son replicadas para cada clon. El diseño experimental prevee parcelas de 1000 m2 cada una, de este modo se evitan problemas de deriva de los pesticidas utilizados en la gestión convencional y no permitidos en los otros tipos de gestión, evitando también el efecto de los preparados biodinámicos pulverizados en el suelo y en la vegetación. Después de 7 años de prueba, los datos relativos al año 2016 muestran que las vides cultivadas con la gestión biodinámica han dado producciones superiores, no habiendo recibido ningún suministro de materia orgánica excepto el abono verde anual entre filas alternas que luego son cortadas o segadas hacia la mitad de mayo. Este efecto se observa sea en Pinot Blanc que en Riesling Renano y es significativo repecto a la gestión convencional. El nitrógeno fácilmente asimilable muestra valores mínimos en la gestión biológica, mientras que entre las otras gestiones no se observan diferencias significativas.

Palabras clave: Gestión del viñedo, biológico, biodinámico, composición uva, nitrógeno fácilmente asimilable.

Introduction

According to the 2017 report on organic farming in Italy (www.sinab.com) and taking into account both the total surface area already certified and the areas undergoing conversion, in 2015 - the most recent available data - there were 83,642 ha of organically cultivated vineyards, of which more than 98% specialized for wine production. In the light of the increasing interest for this farming management, few years ago, a still ongoing experiment was planned to compare different farming systems in Trentino (North-East Italy), a region at the

foot of the Dolomites, a UNESCO world heritage site.

The aim of the present work is to evaluate the possible differences between conventional, organic, and biodynamic farming systems in a particular vineyard for the 2016 harvest and previous years (2012, 2013, and 2015).

Materials and Methods

The experiment began in the fall of 2011 in a vineyard, at the Fondazione E. Mach - San Michele all'Adige, Italy (FEM), which was planted in 2009 and trellised simple pergola (2.8 x 0.5 m). The experimental design included two varieties (Pinot blanc clones LB 16 and LB 18 and Rhine Riesling clones 198-10 GM and 239-25 GM) both on SO4 rootstock, three management systems (conventional, organic, and biodynamic), and 10 repetitions of each treatment. The vineyard was divided in replication parcels of which the different treatments were managed according to their rules depending on the needs of the season. This choice did not allow for a consistent protocol through the years, but resulted in a more accurate test of the reality of each management system.

The management techniques used for each treatment are reported in Table 1. At harvest the following variables were evaluated: grape health, yield, and number of shoots and clusters per vine. Concerning disease, every year, 100 clusters were evaluated five times per management system while 60 vines per treatment were sampled for the ratio of vegetative-grape production. Ten samples of grape clusters per treatment were analysed as juice to determine the soluble solids (Brix), titratable acidity (TA), pH, tartaric acid and malic acid, potassium (K^+) and yeast assimilable nitrogen (YAN). During pruning, the pruning wood was collected to determine the Ravaz index. Data of the vegetative-grape production ratio and juice composition from 2016 is presented in this article as well as aggregate numbers for the years 2012, 2013, and 2015. In 2014, the vines suffered from a heavy hail storm, compromising part of the production so that 2014 was excluded from the study. The data was compiled using STATISTICA 9.1 (StatSoft Inc., Tulsa, OK, USA), applying ANOVA and Tukey test ($p< 0.05$).

Results and Discussion

Vegetative and production data

Pinot blanc

In 2016, the yields of the biodynamic and organic management plots were significantly higher than the conventional management treatment (Table 2). The differences in yield depended on fewer clusters which weighed less than the conventional treatment. The average cluster weight, which was different between the three treatments, was conditioned: in the biodynamic treatment by manual interventions to reduce the compactness of the grapes, in the organic treatment by the side effect of pneumatic defoliation (Hanni and Pedri, 2003) as opposed to manual interventions, and in the conventional treatment, by the specific intervention of gibberellic acid at flowering and thinning at pre-harvest contributed. The combined effect of the manual crop thinning (also emphasizing the significant difference in the number of grapes per shoots) and the chemical crop thinning on the conventional treatment explains the substantial reduction in production. The differing levels of relative yield between the treatments also determined the significant difference in the Ravaz Index between the biodynamic and conventional treatments even if there was no difference in the weights of cane prunings between the three management systems.

Conversely from 2016, in the years preceding it (Table 3), there were no differences between the management systems in yield, while a slight increasing trend was confirmed in the Ravaz Index passing from the conventional treatment, to the organic, to the biodynamic.

Rhine Riesling

Regarding the vegetative production characteristics of Rhine Riesling in 2016, there were significant differences in the yield and the number of clusters per shoot. Yield was higher in the biodynamic treatment relative to the conventional treatment, with the organic treatment at intermediate values (Table 2). The different number of clusters per shoot, like with the Pinot blanc, was the result of the pre-harvest thinning done to the conventional treatment.

The data from the previous seasons, compared to 2016, shows the same tendency regarding the yield, confirming higher yields in the biodynamic treatment in respect to the organic and conventional respectively.

Also concerning the Ravaz Index, the tendency found in 2016 confirms a multi-annual average of growing values passing from the conventional treatment, to the organic, and then to the biodynamic. The trends regarding the yield and the Ravaz Index in 2016 are coherent with the average values found in the preceding years (although the values were not different).

Juice Composition

Pinot blanc

In the Pinot blanc in 2016, significant differences were observed between the relative management systems in regards to Brix, pH and YAN (Table 4). The °Brix levels from the conventional treatment were higher than those of the other two treatments, which were not differentiable between the two. This is explained by the lower yield in the conventional management plots.

Concerning pH, the values were different between the conventional treatment and the organic treatment, while the biodynamic was at an intermediary value; the other variables related to acid composition and the K^+ concentration did not differ. Particularly marked differences were found in relation to the YAN that ranged from 160 mg/L in the conventional treatment, to 127 mg/L in the biodynamic treatment, to 113 mg/L in the organic treatment, with differences between the two extremes. The management effect on the YAN was immediately noticed at the beginning phases of this experiment (Mescalchin et al. 2013). After a few years the YAN in the conventional management parcels remained higher while the biodynamic parcels partially recuperated.

In the multi-year average (Table 5) the absence of differences was confirmed in production levels, as well as Brix, and acid components of the juice. Technologically speaking all of the slightly more elevated values in the conventional management system are not necessarily favourable in the white wine making process and should be held under control. The K^+ concentration showed slightly higher levels in the conventional treatment which were different in respect to the biodynamic treatment in the averaged 3 harvests prior, even if this variable is strongly influenced by the effect of the growing season. The YAN manifested the same dynamics between the treatments both in the 2016 data and the multi-year average respectively; this aspect is of great technological importance because the amount of nitrogen significantly influences the aromatic production of fermentative origin, which is responsible for some fruity components in wines.

Rhine Riesling

Regardless of the different production levels, the Brix levels in 2016 did not significantly differ between the three management styles (Table 4). The pH - at lower levels than the Pinot blanc due to a varietal characteristic - resulted higher in the conventional and biodynamic treatments in respect to the organic treatment. Titratable acidity and tartaric acid showed a difference in the organic and biodynamic treatments in respect to the conventional treatment; with the conventional treatment being lower in both cases. YAN was low in all of the treatments varying from 99 mg/L (biodynamic treatment) and 43 mg/L (organic treatment); there was a difference between the organic treatment and the other two. Comparing the relative data of 2016 with the multi-year average (Table 5) it is confirmed that there is an absence of differences in Brix levels, while averaging previous years annuls the differences in 2016 for pH and tartaric acid. The YAN was relatively higher in the conventional treatment (98 mg/L) also in the period 2012-2015 and based on the multi-year average the differences between the organic and biodynamic treatments tended to decrease.

Conclusions

The organic and biodynamic farming systems have demonstrated results comparable to those obtainable with conventional management. The organic and biodynamic farming systems actually allowed for slightly higher yields than the conventional one, although the complex of results appear to underline that the vegetative-production ratios and the compositional frameworks were substantially the same. Two aspects appear to merit additional attention in the experiment. They concern the more elevated pH in the case of the conventional management treatment and the reduced amount of nitrogen available in the organic and biodynamic treatments. The first variable is fundamental not only in relation to organoleptic aspects but also to the microbiological management of the overall winemaking process; YAN is important in respect to the fruity aroma of wine.

References

HANNI E., PEDRI U., 2003. Defogliazione pneumatica e principali effetti sul diradamento del grappolo. L'Informatore Agrario, 17 71-76.

MESCALCHIN E., ZANZOTTI R., BERTOLDI D., LARCHER R., MALACARNE M., NICOLINI G., ROMAN T., 2013. Grape composition changes during conversion to organic and biodynamic cultivation. Proc. 18th Int. Symp. Group of International Experts of Vitivinicultural Systems for CoOperation (GiESCO), Porto, Portugal. 1047-1051.

Table 1: Details of the cultural practices executed in the different management systems

Cultural practice	Management system		
	Conventional	**Organic**	**Biodynamic**
Herbicide	X		
Mechanical tilling of row	X	X	X
Permanent grass cover crop and mowing	X	X	X
Fertilizer	mineral	organic	
Green manure in alternating rows			X
Pneumatic defoliation	X	X	
Manual removal of lateral shoots			X
Mechanical hedging	X		
Rolling long shoots around top wire		X	X
Chemical elongation of cluster	X		
Manually reducing cluster compactness		X	X
Biodynamic preparations (500, 501)			X

Table 2: Harvest 2016, vegetative-production variables

Parameter	**Pinot blanc**			**Rhine Riesling**		
	Convent.	**Organic**	**Biodynamic**	**Convent.**	**Organic**	**Biodynamic**
No. Shoots	10,1	10,7	10,7	10,2	9,7	10,1
No. Clusters	12,0 b	14,1 ab	14,7 a	19,3	20,4	21,8
Yield (kg)	1,66 b	2,14 a	2,42 a	**2,36 b**	**2,60 ab**	**2,74 a**
Cluster weight (g)	139 c	153 b	165 a	123	148	128
Clusters/Shoots	1,2 b	1,3 a	1,4 a	**1,9 b**	**2,1 a**	**2,2 a**
Weight of cane prunings (kg)	0,41	0,46	0,44	0,44	0,42	0,42
Ravaz Index	4,81 b	5,12 ab	6,44 a	5,99	6,80	6,96

Means within varieties followed by different letters are statistically different according to Tukey test ($p < 0.05$).

Table 3: Harvest 2012, 2013 and 2015, vegetative-production variables

Parameter	**Pinot blanc**			**Rhine Riesling**		
	Convent.	**Organic**	**Biodynamic**	**Convent.**	**Organic**	**Biodynamic**
No. Shoots	11,8 a	11,2 ab	10,9 b	10,5 a	9,4 b	9,5 b
No. Clusters	14,8	14,1	14,0	18,8	17,6	18,6
Yield (kg)	2,11	2,28	2,16	1,87 b	1,88 b	2,07 a
Cluster weight (g)	143 b	163 a	154 a	100 b	110 a	114 a
Clusters/ Shoots	1,3	1,3	1,3	1,8 b	1,9 ab	2,0 a
Weight of cane prunings (kg)	0,33 a	0,31 ab	0,28 b	0,36 a	0,31 b	0,31 b
Ravaz Index	7,08 b	8,56 a	9,10 a	10,5 a	9,4 b	9,5 b

Means within varieties followed by different letters are statistically different according to Tukey test ($p < 0.05$).

Table 4: Harvest 2016, juice composition

Parameter	Pinot blanc			Rhine Riesling		
	Convent.	Organic	Biodynamic	Convent.	Organic	Biodynamic
° Brix	23,6 a	22,3 b	22,6 b	20,6	21,3	20,8
pH	3,39 a	3,32 b	3,35 ab	3,24 a	3,16 b	3,22 a
Titratable acidity (g/l)	5,64	6,01	5,77	6,21 b	6,83 a	6,72 a
Tartaric acid (g/l)	8,86	8,68	8,60	8,46 b	8,88 a	9,01 a
Malic acid (g/l)	2,22	2,34	2,19	2,08	2,04	2,17
Potassium (g/l)	2,05	2,01	2,02	1,81	1,77	1,83
YAN (mg/l)	160 a	113 b	127 ab	87 a	43 b	99 a

Means within varieties followed by different letters are statistically different according to Tukey test ($p < 0.05$).

Table 5: Harvest 2012, 2013 and 2015 juice composition

Parameter	Pinot blanc			Rhine Riesling		
	Convent.	Organic	Biodynamic	Convent.	Organic	Biodynamic
° Brix	20,5	20,7	20,1	19,9	20,6	19,9
pH	3,28	3,23	3,22	3,11	3,09	3,10
Titratable acidity (g/l)	5,27	5,19	5,15	6,02	6,13	6,11
Tartaric acid (g/l)	6,85	6,64	6,53	6,65	6,67	6,68
Malic acid (g/l)	2,12	2,12	2,05	2,47	2,42	2,45
Potassium (g/l)	1,58 a	1,54 ab	1,43 b	1,34	1,35	1,37
YAN (mg/l)	112 a	65 b	84 ab	98 a	67 b	69 b

Means within varieties followed by different letters are statistically different according to Tukey test ($p < 0.05$).