Final report of the test on vine (2002-2004) with the GOBBI products in collaboration with S.Michele all'Adige

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The test was performed on the Cabernet Sauvignon cultivar in the Sormi area during the 2002-2004 period.
The influence of the leaf and/or root fertilizers of the GOBBI line on the nutritional performance and the quantitative-qualitative behaviour of the plants was observed. The experimental groups compared were 7, repeated three times according to an experimental model with randomized units. In the previous years the experimental model had already been detailed, therefore, to facilitate the data reading and understanding, only the compared groups are mentioned:

Treatments

Treatment	**Application**	**Timing**
Test	No fertiliser	
G1	LG 71 2,5 l/ha	Separate bunches Initial blossom Full blossom Fruit set
G2	LG 91 3 l/ha	10 days after fruit set 15 days after 1st treatment
G3	LG 75 750 g/ha + LG 62 2 l/ha + LG 74 3 l/ha	By closing of bunch Onset of ripening
G4	Mycorrcin 5 l/ha Mycorrcin 2 l/ha Mycorrcin 2 l/ha	Early spring 10 cm shoot 10 days before bunch closing
G5	Foliacin 750 ml/ha	Breaking open of leaf buds By end of bloom By closing of bunch
G6	Combined application G4 + G5	

The root fertiliser [Nitrophoska blu spezial, ternary complex made by Compo (12-12-17)] had been spread on the plots of the different experimental groups (G1, G2,G3, G4, G5 e G6) in April for a total contribution of 50 units of nitrogen.

Implementing the treatment was an heavy duty that necessitated several and varied interventions; the controls have addressed:

1. Nutritional status valuation with SPAD (Soil and Plant Analysis Development) on fruit set and ripening onset. The sampling has been implemented by measure of the depth of the green colour of the leaves for a total of 30 leaves per plot.

2. Nutritional status valuation through leaf diagnosis (nitrogen, phosphorus, potassium, calcium, magnesium, sulphur, iron, boron, manganese, zinc and copper content analysis) was performed in the two given phenologic phases. Each sample corresponds to each plot, for a total of 3 samples for each different group.

3. Quantitative data of harvest. From each plot 6 plants have been harvested, from which the number of shoots, the number of bunches and the yield expressed in weight were obtained; from these primary data, the secondary values of real fertility and average bunch weight were obtained.

4. Quantitative data of harvest. From each plot, on three homogenous plants well representative of it, 3 samples have been collected for sugar content, titratable acidity, pH, malic acid, tartaric acid, potassium ion analysis and finally the weight of 100 grape berries was established.

5. Micro-vinification of harvest. About 35 kg grapes have been collected from each experimental group for the purpose of micro-vinification, polyphenols and total anthocyanins analysis. APA (Readily Assimilable Nitrogen) was also measured on the wines. These wines were then evaluated by a taste panel.

6. In wintertime, data about the robustness of the plant were collected, expressed in terms of weight of pruning wood.

Data gathered during the three years of survey have been submitted to ANOVA (Analysis of Variance), including among the variables year, experimental group and year x group interaction (table 1).
Nutritional data and data relative to the SPAD (Soil and Plant Analysis Development) values measured during the separate phenological phases and been added for a better understanding of the results.

Table 1: ANOVA applied to the vegetal production, qualitative and nutritional parameters during the three year survey period. F values and F probability values are included: significant average differences for each variable are indicated in bold print.

Parameter	n° cases	Variables					
		Year		Exp. Group		Year x Group	
		F-Ratio	P	F-Ratio	P	F-Ratio	P
n° shoots	237	18.021	**0.000**	2.225	**0.042**	0.783	0.668
n° bunches	237	8.018	**0.000**	1.510	0.176	1.726	0.063
Actual fertility	237	20.275	**0.000**	1.798	0.101	1.192	0.290
Yield/plant	237	20.850	**0.000**	2.544	**0.021**	1.042	0.412
Average bunch weight	237	45.590	**0.000**	1.770	0.106	1.461	0.141
Weight 100 grape berries	195	134.311	**0.000**	3.911	**0.001**	0.807	0.642
Sugars	195	112.762	**0.000**	2.850	**0.011**	1.839	0.054
Titratable acidity	195	309.361	**0.000**	0.731	0.625	0.947	0.502
pH	195	454.614	**0.000**	0.980	0.440	2.053	0.062
Malic acid	168	334.459	**0.000**	0.483	0.820	0.616	0.826
Tartaric acid	168	54.988	**0.000**	0.828	0.550	1.180	0.302
Potassium ion	168	48.205	**0.000**	0.565	0.758	1.789	0.055
Total polyphenols	63	9.520	**0.000**	0.236	0.962	1.187	0.323
Total anthocyanins	63	976.388	**0.000**	0.910	0.497	1.379	0.214
APA	21	-	-	0.346	0.900	-	-
Pruning wood	285	74.305	**0.000**	8.609	**0.000**	1.273	0.234
Average SPAD	126	22.535	**0.000**	3.270	**0.005**	0.217	0.997
Average leaf nitrogen	126	7.477	**0.001**	1.145	0.342	0.512	0.903
Average leaf phosphorus	126	88.367	**0.000**	1.739	0.119	0.889	0.560
Average leaf potassium	126	22.757	**0.000**	2.573	**0.023**	0.485	0.919
Average leaf calcium	126	26.542	**0.000**	2.073	0.063	0.547	0.879
Average leaf magnesium	126	20.049	**0.000**	4.679	**0.000**	0.302	0.988
Average leaf sulphur	126	8.302	**0.000**	1.423	0.213	0.856	0.593
Average leaf iron	126	18.012	**0.000**	0.752	0.609	0.567	0.864
Average leaf manganese	126	1.151	0.320	1.084	0.377	0.241	0.996
Average leaf boron	126	16.922	**0.000**	0.569	0.754	0.350	0.977
Average leaf copper	126	11.813	**0.000**	0.155	0.988	0.136	1.000
Average leaf zinc	126	7.630	**0.001**	1.680	0.133	0.559	0.870

As documented in Table 2, the data relative to the three year survey period relative to the group are discussed, showing that the year influence has been significant for all researched parameters, with exception of the leaf manganese, while the year x group interaction has never been significant.

After the three year survey period significant differences between the groups are demonstrated in the number of shoots, productivity, weight of 100 grape berries, sugar content, robustness of the plant (expressed in terms of weight of pruning wood and SPAD [Soil and Plant Analysis Development] values), and also in the leaf values of potassium and magnesium.

More specifically:

- exp. group G5 is producing a higher number of shoots than exp. group G2;
- exp. group G4 is more productive than any other; the reference group and exp. group G1, on the contrary, are the less productive and are significantly separated also from exp. group G3 and G6; intermediate values, not statistically different from each other, are found in exp.group G2 and G5;
- the weight of 100 grape berries, in other words their size, varies in the different exp.groups showing the lowest values in exp.group G5, intermediate in the reference group and exp.group G1 and G2, and the highest in exp.group G3; exp.groups G4 and G6 are not demarcated either from G3 or from the intermediate exp.groups;

Table 2: vegetal production, qualitative and nutritional parameters during the three year survey period; separation of the averages of the different groups has been done by Tukey test; significantly different values have been marked by different letters.

	Test	**G1**	**G2**	**G3**	**G4**	**G5**	**G6**
n° shoots	9 ab	9 ab	8 b	9 ab	9 ab	10 a	9 ab
n° bunches	11	12	11	12	13	12	12
Actual fertility	1.30	1.38	1.42	1.44	1.45	1.29	1.44
Yield/plant (Kg)	1.61 c	1.62 c	1.66 bc	1.80 b	2.07 a	1.72 bc	1.78 b
Average bunch weight (g)	141.91	135.38	148.78	153.77	162.74	142.99	150.50
Weight 100 grape berries (g)	132.6 b	136.0 b	135.6 b	143.5 a	138.5 ab	129.5 c	141.1 ab
Sugars (°Brix)	22.08 b	22.51 a	22.44 a	22.24 ab	22.17 ab	22.62 a	22.09 b
Titratable acidity (g/l)	8.15	8.27	8.05	8.31	8.32	8.13	8.41
pH	3.23	3.23	3.21	3.22	3.24	3.21	3.25
Malic acid (g/l)	3.98	4.36	3.96	3.88	4.10	4.02	4.47
Tartaric acid (g/l)	8.33	8.84	8.83	8.91	8.92	8.83	9.13
Potassium ion (g/l)	2.38	2.37	2.35	2.32	2.38	2.32	2.54
Total polyphenols (mg/l)	1666	1666	1670	1663	1678	1674	1693
Total anthocyanins (mg/l)	365	376	366	383	372	387	373
APA (mg/l)	106	105	98	108	129	89	115
Pruning wood (g)	473 b	591 a	532 ab	566 ab	660 a	564 ab	604 a
Avg SPAD	36.2 b	37.3 ab	36.7 ab	37.5 ab	38.5 a	37.0 ab	39.1 a
Avg leaf nitrogen (% s.s.)	2.40	2.52	2.50	2.49	2.56	2.44	2.52
Avg leaf phosphorus (% s.s.)	0.19	0.18	0.20	0.18	0.18	0.19	0.18
Avg leaf potassium (% s.s.)	1.11 ab	1.12 ab	1.01 b	1.14 ab	1.12 ab	1.04 b	1.16 a
Avg leaf calcium (% s.s.)	2.54	2.64	2.84	2.70	2.68	2.73	2.61
Avg leaf magnesium (% s.s.)	0.50 ab	0.51 ab	0.60 a	0.48 b	0.53 ab	0.58 a	0.51 ab
Avg leaf sulfur (% s.s.)	0.15	0.16	0.16	0.15	0.16	0.15	0.16
Avg leaf iron (ppm s.s.)	55	56	54	56	57	55	57
Avg leaf manganese (ppm s.s.)	263	288	281	275	282	276	311
Avg leaf boron (ppm s.s.)	34	39	34	35	34	34	36
Average leaf copper (ppm s.s.)	177	197	191	192	190	241	233
Average leaf zinc (ppm s.s.)	50	52	53	69	55	55	53

- the sugar content appears significantly raised in exp.groups G1, G2 and G5 in comparison with the reference group and exp.group G6;
- The degrees of robustness of the plant expressed in terms of weight of pruning wood, also demonstrate that exp.group G1, G4 and G6 are clearly higher than those of the reference plants;
- in a parallel way, the SPAD values show the same tendency, albeit without difference, with exp.group G1; even if the average values are not statistically different, the nitrogen leaf levels show the same tendency;
- the leaf potassium levels are significantly lower in exp.groups G2 and G6 when compared to G6, while the magnesium levels show higher levels in G2 and G5 when compared to G3;
- wines and musts have not shown statistically significant variations for polyphenol, anthocyanin and readily assimilable nitrogen levels;
- similarly, the yearly analysis of the produced wines (Table 3) does not show marked variations, with the exception of a tendency to a higher alcohol content in exp.groups G1, G5 and G2 and lower content in the reference group;
- the tasting profiles of the wine produced (figure 1) demonstrate, albeit with differences in the different years, that fertilisation can contribute to change some factors of the tasting profile; more specifically, the non fertilised exp.group scores a very low aromatic and tasting score, clearly separating it from all other wines, even without taking into account the spiced, herbal, bitter, phenolic and citric caracters. This confirms what had already been observed after the first year of the survey period.
- the G5 wine proves to be the most appreciated for its rich floral, tobacco and sour cherry taste. The G1 and G3 wines were also very much appreciated, particularly the abundance of red fruit taste in G3. G4 and G6 wines, in general, have shown in the years average to low tasting profiles with limited sour cherry and red fruit taste, comparable to the non fertilised group.

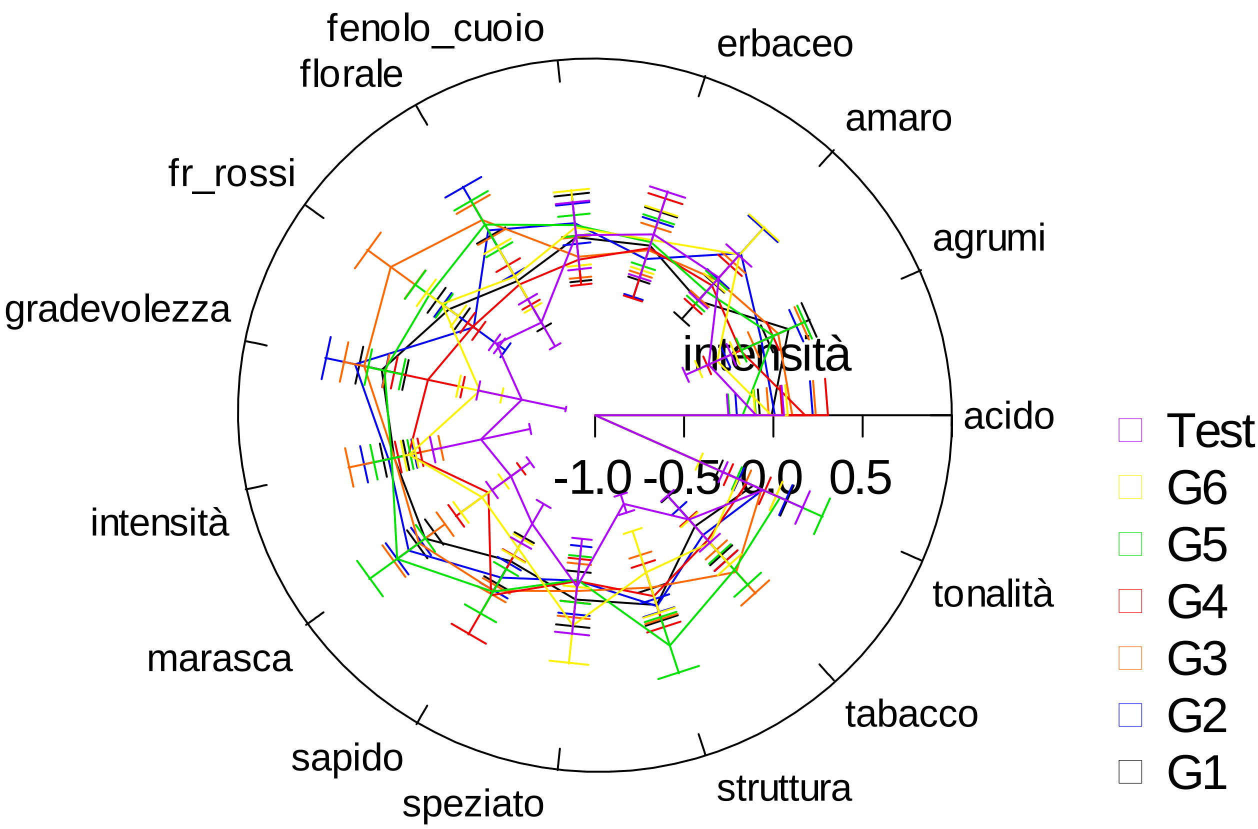

Figure 1: tasting profile analysis of the wines in the different experimental groups.

Average values of the three years ± standard error.

Translation of the terms in Fig 1

Fenolo_cuoio	Phenol_leather
Erbaceo	Herbal
Amaro	Bitter
Agrumi	Citrus
Acido	Acid
Tonalità	Colour
Tabacco	Tobacco
Struttura	Structure
Speziato	Spiced
Sapido	Tasty
Marasca	Sour cherry
Intensità	Fullness
Gradevolezza	Pleasantness
Fr_rossi	Red fruits
Florale	Floral

Table 3: Wines and musts analysis of the three years, comparing the experimental groups.

2002

Parameter	Test	G1	G2	G3	G4	G5	G6
APA must (mg/l)	164	139	133	150	167	128	156
Total anthocyanins (mg/ml)	184	201	204	198	203	212	206
Total polyphenols (mg/l)	1569	1617	1648	1632	1636	1651	1614
Must sugar content (g/l)	197	195	183	187	201	208	192
Must °Brix	20.66	20.62	19.40	20.00	20.68	21.40	20.14
Total must acidity (g/l)	6.00	7.40	6.40	6.60	6.80	7.20	7.50
Must pH	3.68	3.33	3.39	3.44	3.43	3.37	3.33
Wine density	0.9951	0.9947	0.9945	0.9946	0.9949	0.9944	0.9952
Wine alcohol (°)	11.64	11.99	12.07	11.89	11.78	12.32	11.74
Wine sugar (g/l)	1.00	1.0	0.9	0.9	1.1	0.8	0.8
Total wine acidity (g/l)	4.20	4.4	4.6	4.4	4.2	4.1	4.2
Volatile wine acidity (g/l)	0.48	0.34	0.39	0.39	0.37	0.29	0.42
Wine pH	4.17	3.90	3.89	3.98	4.01	3.94	4.02
Free wineSO_2	36	46	49	43	48	49	48
Total wine dry matter	28.0	27.3	27.0	26.6	27.1	27.4	27.8
Wine ashes	4.13	3.74	3.60	3.71	3.80	3.58	4.01

2003

	Test	G1	G2	G3	G4	G5	G6
APA must (mg/l)	74	96	92	85	96	77	96
Total anthocyanins (mg/ml)	389	382	377	371	369	381	396
Total polyphenols (mg/l)	1708	1740	1662	1644	1740	1710	1733
Must sugar content (g/l)	211	225	225	223	214	222	219
Must °Brix	21.68	22.86	22.85	22.48	21.89	22.54	22.33
Total must acidity (g/l)	4.0	5.2	4.9	5.3	5.5	5.0	5.1
Must pH	3.76	3.45	3.44	3.48	3.42	3.42	3.51
Wine density	0.9947	0.9948	0.9949	0.9947	0.9948	0.9946	0.9950
Wine alcohol (°)	12.38	13.26	13.26	12.94	12.48	13.01	12.89
Wine sugar (g/l)	0.9	0.9	0.8	0.8	0.9	0.8	0.8
Total wine acidity (g/l)	5.2	4.3	4.3	4.4	4.5	4.6	4.5
Volatile wine acidity (g/l)	0.38	0.39	0.41	0.37	0.39	0.40	0.39
Wine pH	3.95	3.95	3.93	4.02	3.97	3.94	3.96
Free wineSO_2	6	7	5	3	5	5	5
Total wine dry matter	30.2	31.2	31.0	31.4	31.5	30.9	31.4
Wine ashes	3.98	3.87	3.59	3.70	3.77	3.75	3.84

2004

	Test	G1	G2	G3	G4	G5	G6
APA must (mg/l)	80	79	70	90	124	63	93
Total anthocyanins (mg/ml)	522	545	518	578	544	567	517
Total polyphenols (mg/l)	1720	1639	1700	1715	1658	1662	1732
Must sugar content (g/l)	221	229	226	226	224	232	226
Must °Brix	22.78	23.08	22.86	22.84	22.72	23.24	22.88
Total must acidity (g/l)	4.8	4.5	5.0	5.2	5.3	5.1	5.2
Must pH	3.40	3.41	3.35	3.32	3.34	3.39	3.32
Wine density	0.9945	0.9939	0.9937	0.9940	0.9942	0.9941	0.9943
Wine alcohol (°)	13.00	13.49	13.27	13.37	13.17	13.48	13.13
Wine sugar (g/l)	1.5	0.8	0.9	0.8	0.8	0.8	0.8
Total wine acidity (g/l)	4.5	4.3	4.7	4.3	4.5	4.5	4.4
Volatile wine acidity (g/l)	0.39	0.56	0.55	0.43	0.53	0.54	0.51
Wine pH	3.96	3.94	3.88	3.93	3.97	4.00	3.99
Free wineSO_2	31	35	35	39	40	42	32
Total wine dry matter	30.9	30.4	29.9	30.1	30.5	31.3	30.6
Wine ashes	3.79	3.70	3.47	3.73	3.62	3.89	3.71
Wine tartaric acid (g/l)	1.62	1.63	1.58	1.62	1.57	1.60	1.59
Wine malic acid (g/l)	0.74	0.80	0.91	0.59	0.84	0.86	0.83
Wine lactic acid (g/l)	2.31	2.19	2.27	2.27	2.47	2.38	2.50
Wine glycerol (g/l)	11.02	10.54	10.38	10.63	10.62	10.88	10.49
Wine potassium ion (g/l)	1.7	1.5	1.6	1.6	1.7	1.8	1.7

The data obtained from tasting confirm in any case what had been observed from the average values in terms of sugar gain and plant productivity in the different groups. This shows that, according to the model of this survey, even minimal production gains compatible with the fertilising effect, can contribute to the shifting of the intrinsic balance of the plant.
Such data prove that the different fertilisation strategies, either trough the roots or the leaves, can influence the plant quantitative –qualitative performance and that an adequate management of the time of intervention can be of strategic importance to obtain better plants that will produce more enjoyable wines better appreciated by the consumer.