

Photosynthesis and refractometric measurements on *Vitis vinifera*

Experiment 1: gas analysis

Photosynthesis can be influenced by different environmental factors. Using the Q-box, the effect of these parameters can be measured. For the following experiment, we decided to change the light intensity to measure its effect on photosynthesis.

Results

The initial setup of the experiment concluded four measurements of ten minutes each of the CO₂ level with the Q-box. The goal was to determine whether different LED light intensities had an effect on photosynthesis. However when looking at the result, the Q-box had only registered the CO₂ level for five minutes. On top, the only effect visible was at an average LED light intensity of 1331,9 $\mu\text{mol quanta/m}^2/\text{s}$. Output of the Q-box for the CO₂ level is shown in figure 1.

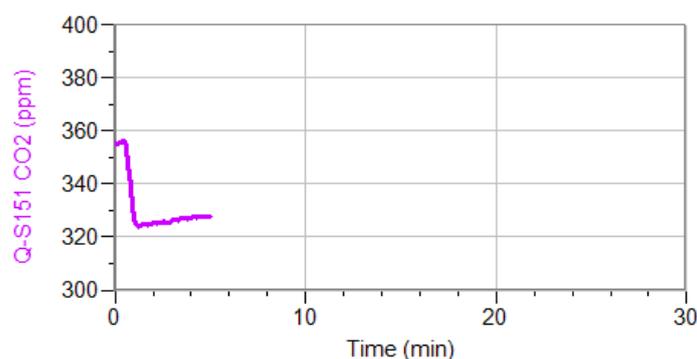


Figure 1: Five minute registration of the CO₂ level (ppm) of the Q-box, LED light intensity was set on 1331,9 $\mu\text{mol quanta/m}^2/\text{s}$.

The results show an initial concentration of 355 ppm CO₂, followed by a drop to 324 ppm. This lower value augmented steadily to 327 ppm at the end of the measurement.

Discussion

As light intensity increases, the rate of light-dependent reaction, and therefore photosynthesis in general increases proportionally. If this increases further, photosynthesis is limited by other factors and the rate plateaus. At the start of the experiment, CO₂ is present at a constant rate of 355 ppm because of the calibration air used for the Q-box. The excess in LED light triggers photosynthesis quickly so the drop to 324 ppm is reached after 1,2 minutes. The photosynthesis reaction is saturated by the excess in light, so the concentration of CO₂ slowly starts to accumulate again through respiration until the end of our measurement.

Experiment 2: sugar level in grapes

In the vineyard of St Peter's Abbey, four varieties of *Vitis vinifera* are present: Sauvignier gris, Sirius, Phoenix and Johanniter. We determined the sugar level of 10 grapes of each variety using a refractometer. Appendix 1 shows a plan of the vineyard, including which rows we used for sampling.

The approach of the refractometer gives a fast determination of density of the grape juice in the field. Based on these measurements, we hope to predict the use of this year's harvest.

Results

The results of the individual measurements are shown in table 1.

Table 1. Measurements of sugar level in four varieties of *Vitis Vinifera*.

Souvignier gris		Sirius		Phoenix		Johanniter	
%Vol	°Oe	%Vol	°Oe	%Vol	°Oe	%Vol	°Oe
8,4	65	4,3	30	6,8	54	10,2	76
10,2	75	9,2	69	9,6	72	10,5	80
13,6	97	9,4	70	10,2	75	10,1	75
12	87	9,1	68	10	74	10,4	78
9,4	68	9,2	69	9,4	70	10,3	77
14,2	99	9,3	70	9,2	68	10,3	77
13	94	9,3	70	4,2	36	10	74
11,8	85	4,3	30	6	48	10,5	80
11	80	8,2	63	10,4	76	10,5	80
11,4	81	9	67	8	62	10,4	78

Starting from these measurements, the mean and standard deviation were calculated for each of the four varieties using Microsoft Excel (2010). The results are shown in table 2.

Table 2. Mean and standard deviation of the different varieties of *Vitis vinefera*.

	Souvignier gris		Sirius		Phoenix		Johanniter	
	%Vol	°Oe	%Vol	°Oe	%Vol	°Oe	%Vol	°Oe
Mean	11,5	83,1	8,13	60,6	8,38	63,5	10,32	77,5
Stdev	1,73954	11,04038	1,941159	15,42854	1,97474	12,73774	0,166132	2,012461

The calculated means were converted from °Oechsle to °Brix and g/l using an online converter¹. The values in °Brix and g/l are presented in table 3.

Table 3. Sugar level values in °Brix and g/l of the different varieties of *Vitis vinefera*.

Souvignier gris		Sirius		Phoenix		Johanniter	
°Brix	g/l	°Brix	g/l	°Brix	g/l	°Brix	g/l
20,03	216,95	14,88	157,82	15,55	165,37	18,76	202,14

Discussion

Grapes of the variety *Souvignier gris* had a mean sugar level of 83,1°Oe. These grapes can be used to make white wine with an alcohol content of 11,5%. The grapes of variety *Johanniter* had a mean sugar level of 77,5°Oe, so this will lead to an alcohol content of 10% which is less than the alcohol content in the variety *Souvignier gris*. The *Johanniter* grapes can rather be used to make sparkling wine. However if you chaptalize (add sugar), you will increase the alcohol content and then you can also make white wine out of these grapes.

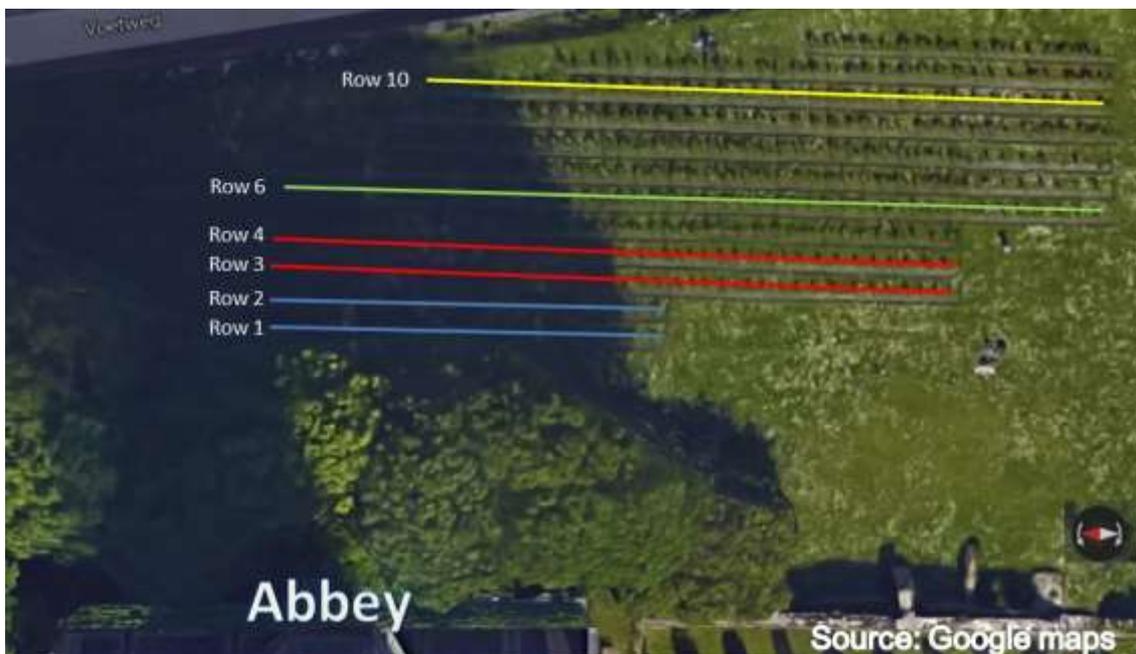
Sirius and *Phoenix* grapes both have a mean sugar level that is too low to make wine of, 60,6°Oe and 63,5°Oe respectively. Wine is made of grapes which have a minimum sugar level of 70°Oe, so it is too early for these grapes to be harvested. However if these grapes will be harvested right away, the wine producers can still chaptalize to make wine with a sufficient alcohol content.

References

¹Musther, J. (September 2013). *VinoCalc, Gravity/Density/Sugar Conversions*. Retrieved October 7, 2016, from <http://www.musther.net/vinocalc.html>.

Appendix 1

To illustrate how we took the samples, a view from Google maps was extracted. The legend indicates which variety is situated where. From rows one and two, but also from rows three and four, five grapes were measured from each row with regular intervals. Rows six and ten were sampled by ten grapes of the same row.



- Phoenix
- Souvignier gris
- Sirius
- Johanniter