ELEMENTAL SULPHUR SPRAY – PART 1:

RESIDUE CONCENTRATIONS AT HARVEST

Dr. Carien Coetzee

Basic Wine

29 September 2021

Elemental sulphur (S^0) is an effective, durable and economical fungicide for the management powdery mildew in vineyards. The advantage of S^0 over alternatives include its low cost, good efficacy, low risk of resistance development and its acceptability within various production systems.

But **sulphur residues** present on the grapes at harvest can have adverse effects and **concentrations exceeding 10 µg/g in musts are associated with increased hydrogen sulphide (H_2S) formation** during fermentation[1–3]. Growers and winemakers are therefore cautious when applying elemental sulphur closer to the harvest date for fear of increased **residual elemental sulphur being transferred into the juice.**

Three years of field studies investigated the **persistence of S^0 in the vineyard** as well as the **concentrations during pre fermentative winemaking stages**. The findings of the study were published in an article titled

Persistence of elemental sulfur spray residue on grapes during ripening and vinification[4]

Elemental S^0 spray was applied at different times and dosages. Different commercial formulations were also tested. The **transfer of S^0 to the must after harvest and crushing as well as the influence of vinification factors such as whole bunch pressing, length of skin contact and must clarification on the proportion of S^0 transferred into the must were also investigated** and will be discussed in Part 2 of this blog series.

Materials and Methods

Vineyard trials were conducted on Chardonnay and Riesling vines. S^0 was applied using sprayer operating at 2070 kPa and delivering 935 L/ha through seven hollow cone nozzles.

Two commercial S^0 formulations were tested:

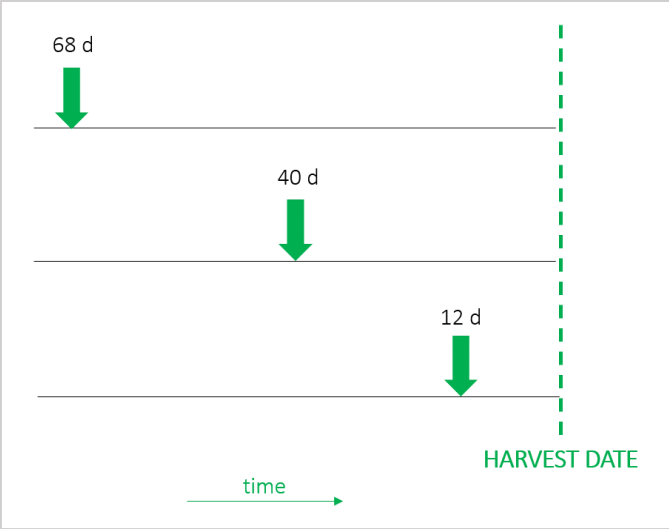
1) a micronized formulation

2) a wettable powder formulation

The method of S^0 residue quantification is described in the original publication[4].

Results

Vineyard trial 1

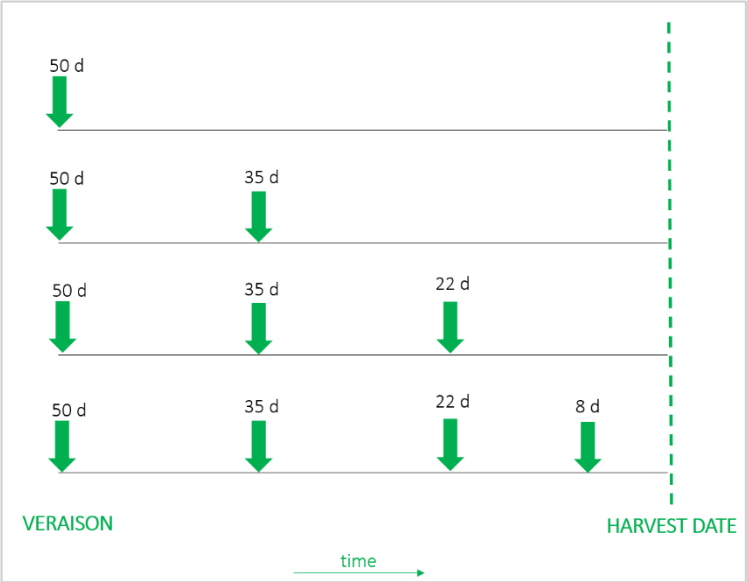


During trial 1, a single **micronized formulation** was applied either 68, 40 or 12 days before harvest at a rate of either 2.7 or 5.4 kg/ha (6 treatments). This was compared to a control where no S^0 was applied (1 control).

Trial 1: Results

- The control vines did not have any measurable residues
- At harvest, there was **no practical difference** in S^0 residue concentration between the **application rate** of 2.7 vs 5.4 kg/ha S^0 and both dosages delivered **approximately the same concentration** (which varied according to the timing of application).
- The **timing of application** was shown to be the major factor affecting the residue concentration:
    - → Applying S^0 **12 days before harvest** resulted in residues of approximately 40-60 µg/g.
    - → Applying S^0 **40 days before harvest** resulted in residues of less than 5 µg/g.
    - → Applying S^0 **68 days before harvest** resulted in residues of even less than the 40 days application and was not statistically different from the control sample where no S^0 was applied.

Vineyard trial 2



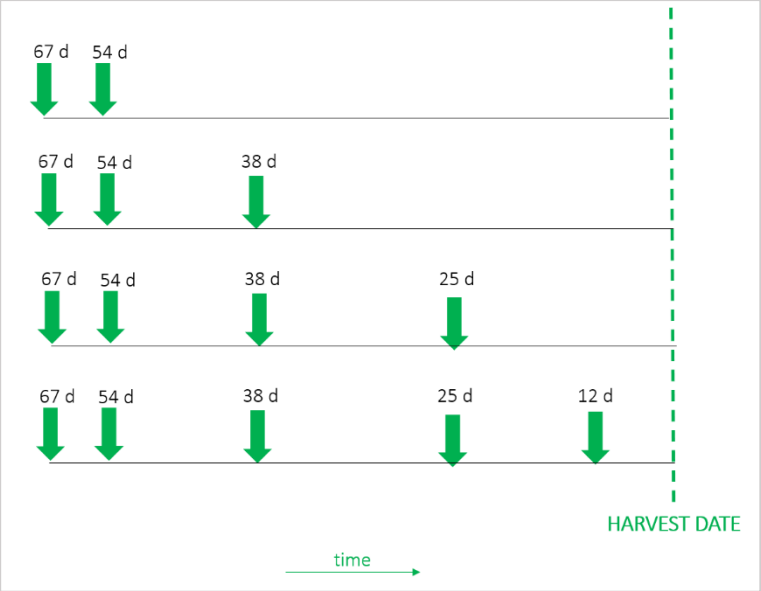
In trial 2 the **first micronized formulation was applied at vériason** whereafter sprays were applied at approximately **two-week intervals** and continuing until either 50, 35, 22 or 8 days before harvest. The treatment which ceased 50 days before fermentation was applied at a rate of 2.7 kg/ha S^0, whereas the latter three timing regimes received applications of either wettable sulphur at 2.7 or 5.4 kg/ha S^0 or micronized sulphur at 5.4 kg/ha S^0 (10 treatments). This was compared to a control where no S^0 was applied (1 control).

Trial 2: Results

- In trial 2, both the **application** (formulation-concentration) **and the timing** of application impacted the final residue concentration on the grapes at harvest.
- When applied until **eight days before harvest** the residue concentration exceeded 10 µg/g (all three rates of application). The 5.4 kg/ha micronized sulphur delivered the highest concentration of residual S^0, while the wettable sulphur formulations resulted in lower residual S^0 concentrations. The application of 2.7 kg/ha S^0 in wettable powder formulation was only about one third the concentration of those following applications of 5.4 kg/ha in a micronized form.
- When the sprays ceased at **22 days before harvest** residues from the wettable powder at the lower rate resulted in an average concentration of around 6 µg/g. Applications of either formulation at the higher rate resulted in levels exceeding 10 µg/g.

- At **35 days before harvest**, all three S^0 treatments (formulation and dosage) resulted in S^0 residues below 5 µg/g.
- At **50 days before harvest**, the micronized formulation at 2.7 kg/ha S^0 resulted in a residue concentration of less than 0.5 µg/g.

Vineyard trial 3



In trial 3 the vines were sprayed at a rate of 4.5 kg/ha S^0 in **either micronized or wettable powder** formulation **beginning on 67 days before harvest and continuing at approximately two-week intervals** until 54, 38, 25 or 12 days before harvest. An additional treatment was included that received micronized sulphur at 4.5 kg/ha in the first application and 2.2 kg/ha in the final two applications, 54 and 38 days before harvest.

Trial 3: Results

- Residues were near or well above 10 µg/g when either formulation was applied until either **25 or 12 days before harvest**.
- At **12 days before harvest**, the micronized sulphur resulted in a higher residual S^0 concentration when compared to the wettable sulphur. At **25 days before harvest**, the opposite trend was observed with the wettable sulphur resulting in a higher residual S^0 concentration when compared to micronized sulphur.
- There was no significant difference in residue concentration between the **38 and 54 days before harvest** application.

Conclusion

S^0 application rate and specific formulation affected the residual S^0 concentration on the grapes at harvest. **Residues consistently exceeded the 10 µg/g threshold when S^0 was applied within 25 days of harvest** and in all the trials, only those treatments ceasing more than 50 days before harvest were below 1µg/g. The S^0 residues did not exceed 4.6 µg/g when application ceased by 35 to 38 days before harvest and were typically below 3 µg/g.

In general, **residue concentrations were lower for wettable powder formulations** versus a micronized formulation applied at the same time and dosage. The **S^0 residue concentration increased proportionally to the application rate** when the timing and the formulation were constant. In all the trials, **ceasing the application 35 days before the harvest date resulted in S^0 residues below the 10 µg/g** concentration associated with increased H_2S production.

Part 2 of this two-part series will briefly outline the fate of these residues during pre fermentative grape and must processing operations[4].

References

(1) Acree, T. E.; Sonoff, E. P.; Splittstoesser, D. F. Effect of Yeast Strain and Type of Sulfur Compound on Hydrogen Sulfide Production. *American Journal of Enology and Viticulture* **1972**, *23* (1), 6 LP – 9.

(2) Rankine, B. C. Nature, Origin and Prevention of Hydrogen Sulphide Aroma in Wines. *Journal of the Science of Food and Agriculture* **1963**, *14* (2), 79–91. https://doi.org/10.1002/jsfa.2740140204.

(3) Schutz, M.; Kunkee, R. E. Formation of Hydroge Sulfide from Elemental Sulfur During Fermentation by Wine Yeast. *American Journal of Enology and Viticulture* **1977**, *28* (3), 137–144.

(4) Kwasniewski, M. T.; Sacks, G. L.; Wilcox, W. F. Persistence of Elemental Sulfur Spray Residue on Grapes during Ripening and Vinification. *American Journal of Enology and Viticulture* **2014**, *65* (4), 453–462. https://doi.org/10.5344/ajev.2014.14027.

Photo by Gabriella Clare Marino on Unsplash