

Effects Of Cover Crops And Management Practices On Grapevine Vigour, Nutrient Dynamics And Biochemical Response

Gumani Nemaluma[1,2*], Prof Mulaudzi T[1], Dr Howell CL[2], Dr Murovhi R[3]

[1] University of the Western Cape, Department of Biotechnology
[2] Agricultural Research Council, Infruitec-Nietvoorbij
[3]Agricultural Research Council, Levubu, Limpopo

05-06 August 2026, Table Grape Conference, Allée Bleue, Franschoek

SATI South African Table Grape Industry

SASEV South African Society for Enology & Viticulture

University of the Western Cape

Motivation

- There has been a great decline in soil quality and agricultural production due to environmental factors and climate change.
- As such, farmers are adopting sustainable cultivation practices; hence, the use of **cover crops** is becoming an increasingly important strategy (Figure 1).
- Similarly, table grape producers are showing growing interest in the adoption of cover crops because of their multiple benefits.
- Although the benefits of cover crops are well documented for wine grapes in South Africa, their effects on biochemical responses of table grapevines remain poorly understood.



Figure 1: Cover crops in the vineyard (Location, Laborans farm, Paarl, (Photograph by Gumani Nemaluma, 2024).

Aim of the study: To elucidate the effects of cover crop cultivation on the biochemical responses of table grapevines and determine how these responses influence grapevine performance, thereby providing scientific evidence to support sustainable cover crop utilisation in table grape production.

Study site

- The project was carried out on the Laborans farm (Sweet Globe vineyard) located in the Noorder-Paarl area in the Western Cape Province of South Africa.
  - **Latitude:** 33°42′17″ S (−33.7047)
  - **Longitude:** 18°57′56″ E (18.9655)

- The climate of the area is Mediterranean, with warm summer and moderate winter rainfall.



Experimental layout

- Five main treatments were applied, namely, Oats (T1), Medics (T2), Grazing vetch (T3), Mixture of Triticale and Lupins (T4), and a Control, which represents farmer standard practices (T5).
- Cover crops were established during the winter of May 2024 and allowed to grow until the end of September.

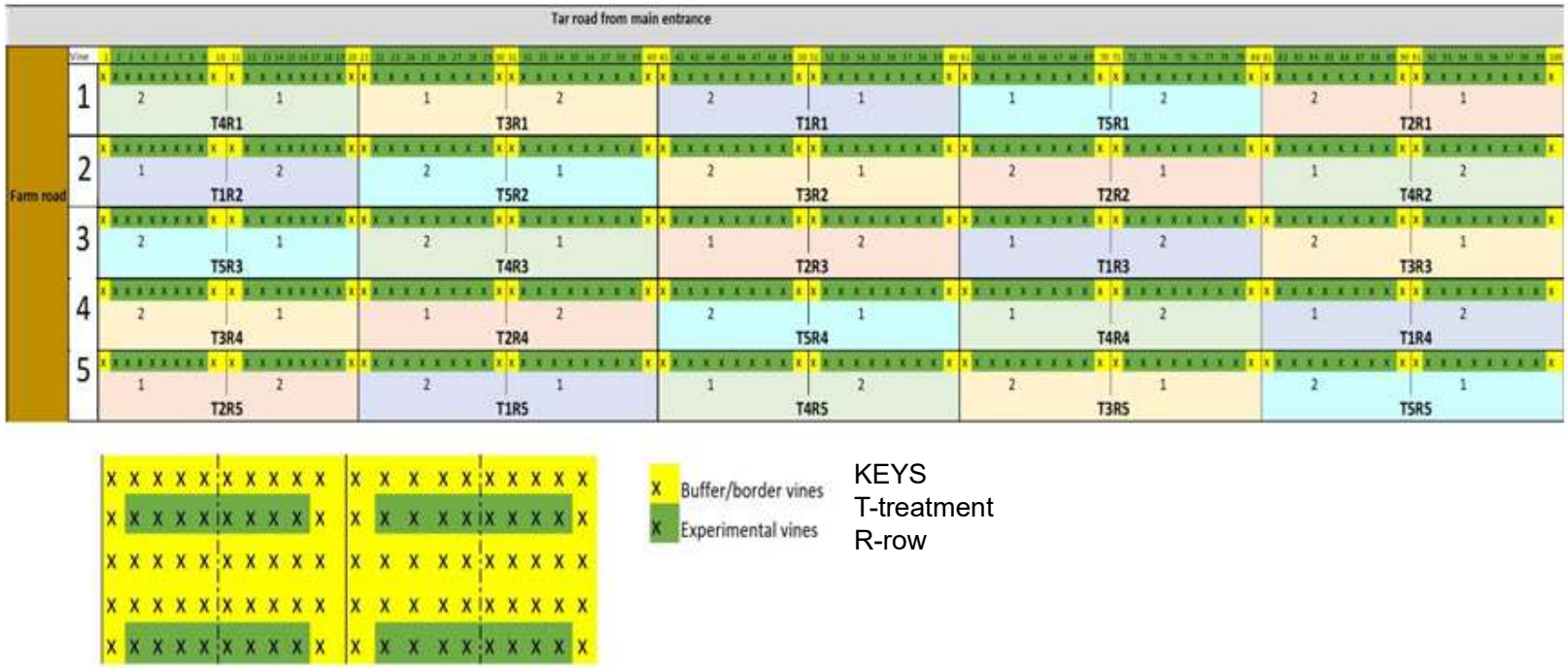


Figure 2: The field plan with the treatments and replications as well as the plot layout.

Management practices

- Two management (termination) practices were applied, namely: Chemical control and Slashed.



Figure 3: A photograph of an experimental plot in November, 2024 where cover crops were controlled by chemical (A) and slashed (B) treatments. For the slashed treatment plant residues were placed on the vine row.

Measurements

1. PHYSIOLOGICAL TRAITS

- Cane mass was measured in winter and weighed using a hanging balance.



2. BIOCHEMICAL TRAITS

OXIDATIVE STRESS MARKERS



Oxidative stress markers:

- Hydrogen peroxide (H_2O_2)
- Malondialdehyde (MDA)

Osmolytes & Antioxidants

- Proline
- Ascorbate peroxidase (APX)

NUTRIENT CONTENT



Macronutrients:

- Nitrogen (N)
- Phosphorus (P)
- Potassium (K^+)
- Calcium (Ca^{2+})
- Magnesium (Mg^{2+})

Grapevine vigour

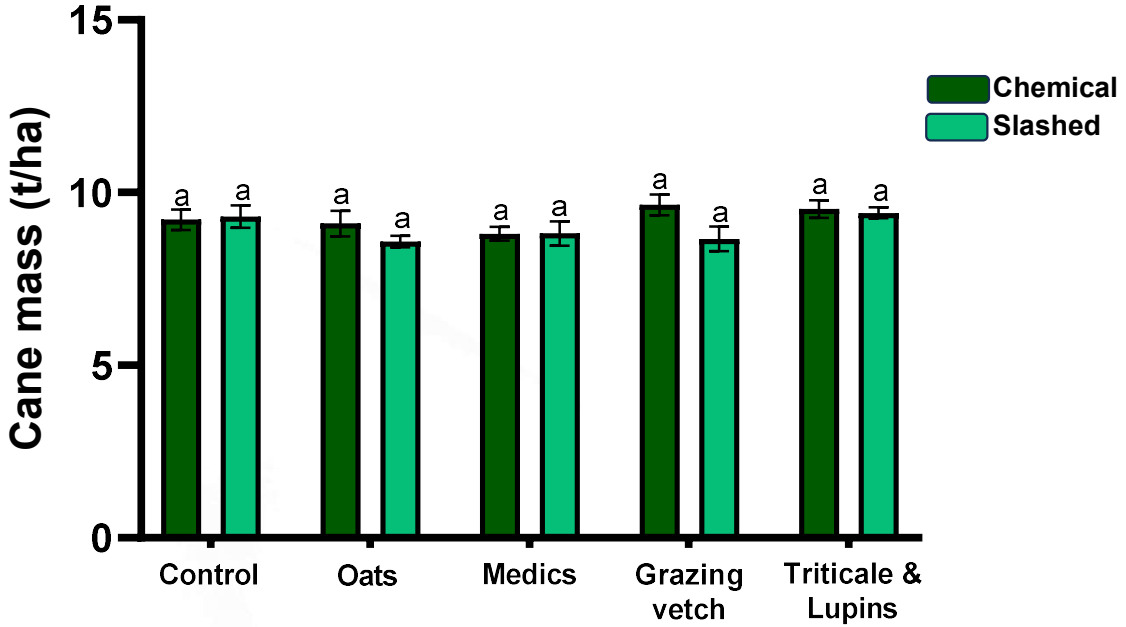


Figure 4: Cane mass of the Sweet Globe™ grapevine for the different cover crop treatments and termination methods were measured at pruning in winter 2024. Values designated by the same letter do not differ significantly ($p \leq 0.05$).

Summary: Cover crop species and their management practices maintained grapevine vigour, as indicated by similar cane mass across treatments, suggesting that cover crops can be integrated into vineyard management without compromising vegetative growth.

Effects of cover crops on oxidative stress markers

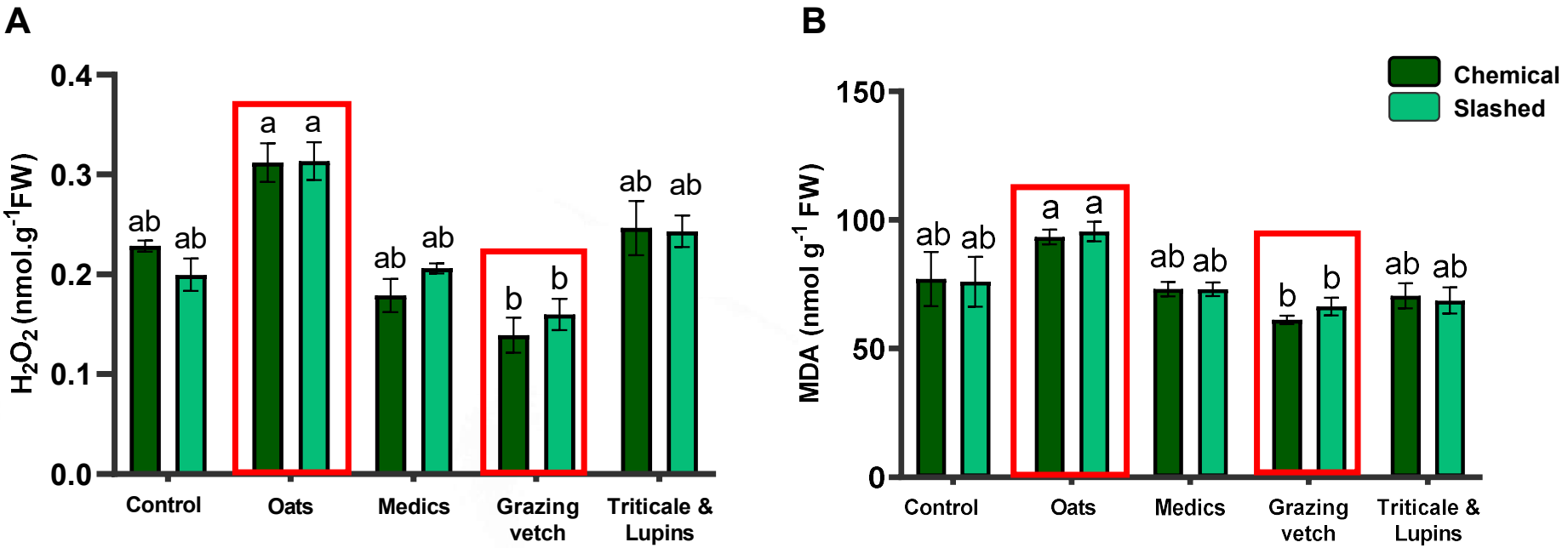


Figure 5: Hydrogen peroxide (H_2O_2) (A), and Malondialdehyde (MDA) (B) levels of Sweet Globe^{TM} grapevines in response to cover crop and termination methods. The data are presented as mean ± SD, and significant differences ($p \leq 0.05$) were determined using one-way ANOVA at a 95% confidence interval.

Summary: Under oats treatment, grapevine accumulated slightly high levels of oxidative stress markers (H_2O_2 and MDA) under both termination methods. On the contrary, grazing vetch prevented the accumulation of these markers indicative of reduced oxidative stress. Therefore, healthier vines can direct energy use for growth and fruit development, rather than stress management.

Osmolyte content and antioxidant signalling

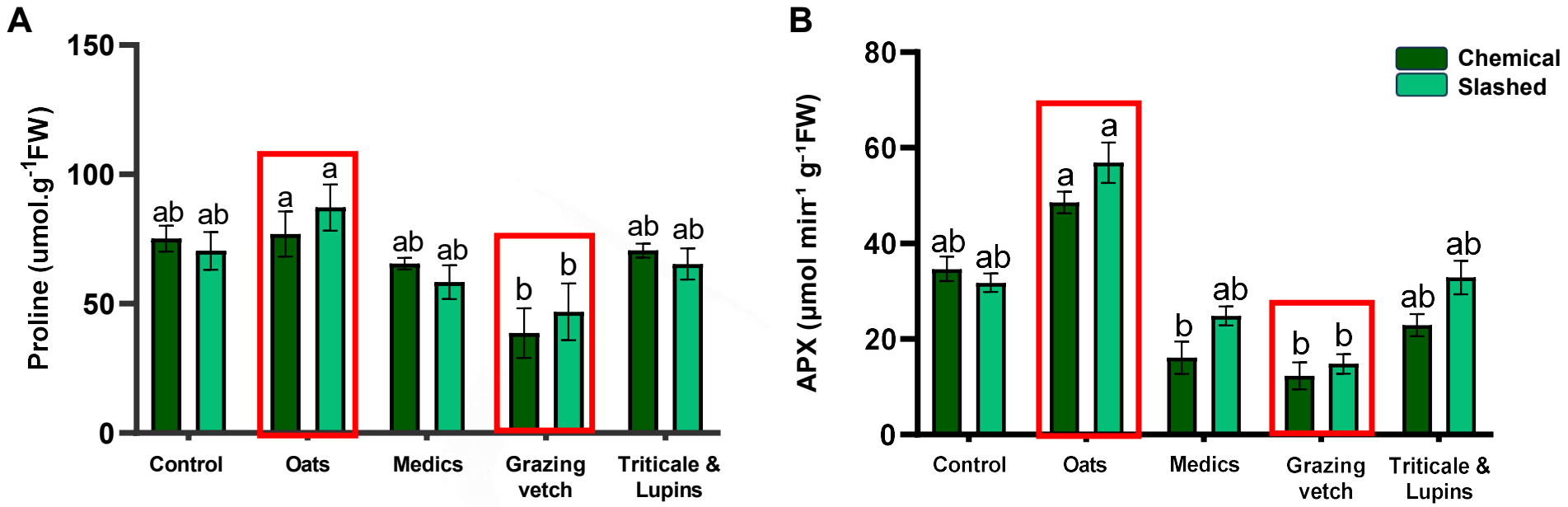


Figure 6: Proline (A), and APX (B) levels of Sweet Globe™ grapevine in response to cover crop and termination methods. The data are presented as mean ± SD, and significant differences ($p \leq 0.05$) were determined using one-way ANOVA at a 95% confidence interval.

Summary: Grapevines accumulated low proline levels and Ascorbate peroxidase (APX) activity in response to grazing vetch under both termination methods, as compared to the control, indicative of improved osmotic adjustment and antioxidant signalling respectively. On the contrary, Oats treatment enhanced both proline accumulation and APX activity, indicative of their role to induce stress tolerance in grapevine.

Cover crops influenced grapevine nutrient uptake

Table 2: Nutrient content in Sweet Globe™ grapevine in response to cover crop and termination treatments. Data is presented as mean ± SD, and significant differences ($p \leq 0.05$) were determined using one-way ANOVA at a 95% confidence interval, across the different treatments.

Cover crop treatment	Termination	N (%)	P (%)	K^+ (%)	Ca^{2+} (%)	Mg^{2+} (%)
Control	Chemical	2.87 ± 0.12^{b} *	0.32 ± 0.004^{ab}	0.85 ± 0.08^{a}	1.88 ± 0.18^{ab}	0.32 ± 0.02^{a}
Control	*Slashed*	*2.93 ± 0.21^{ab}*	*0.31 ± 0.01^{ab}*	*0.87 ± 0.07^{a}*	*1.80 ± 0.19^{b}*	*0.31 ± 0.03^{a}*
Oats	Chemical	3.02 ± 0.18^{ab}	0.33 ± 0.02^{a}	0.90 ± 0.08^{b}	1.98 ± 0.17^{ab}	0.28 ± 0.03^{c}
Oats	*Slashed*	*3.00 ± 0.16^{a}*	*0.33 ± 0.01^{a}*	*0.92 ± 0.05^{a}*	*1.97 ± 0.19^{ab}*	*0.28 ± 0.02^{a}*
Medics	Chemical	2.93 ± 0.11^{ab}	0.30 ± 0.02^{b}	0.89 ± 0.07^{b}	2.14 ± 0.20^{a}	0.31 ± 0.02^{a}
Medics	*Slashed*	*2.93 ± 0.13^{a}*	*0.30 ± 0.01^{b}*	*0.88 ± 0.02^{a}*	*2.20 ± 0.21^{a}*	*0.32 ± 0.03^{a}*
Grazing vetch	Chemical	3.01 ± 0.11^{ab}	0.32 ± 0.02^{ab}	0.91 ± 0.05^{b}	1.86 ± 0.08^{ab}	0.28 ± 0.01^{c}
Grazing vetch	*Slashed*	*3.06 ± 0.17^{a}*	*0.32 ± 0.02^{ab}*	*0.88 ± 0.03^{a}*	*1.90 ± 0.16^{ab}*	*0.30 ± 0.01^{a}*
Triticale & Lupins	Chemical	2.12 ± 0.09^{a}	0.31 ± 0.01^{ab}	0.85 ± 0.04^{a}	1.85 ± 0.05^{ab}	0.32 ± 0.02^{a}
Triticale & Lupins	*Slashed*	*3.11 ± 0.08^{a}*	*0.30 ± 0.02^{ab}*	*0.84 ± 0.11^{a}*	*1.87 ± 0.24^{ab}*	*0.31 ± 0.01^{a}*

*Values designated by the same letters for each data set within a column do not differ significantly ($p \leq 0.05$).

Summary: Oats and grazing vetch significantly improved nutrient content in grapevine as compared to the control, indicative of balanced nutrient uptake. This translate to healthier vines and hence quality grapes.

Take home message



- This is the first study to investigate the combined effects of cover crop species and management practices on the biochemical responses of table grapevine in a South African vineyard.
- Grazing vetch and oats showed potential to improve nitrogen availability, which may reduce the need for synthetic nitrogen fertilisers in future, lowering production costs and environmental impacts.
- These preliminary findings suggest that cover crops can contribute to sustainable viticulture by improving grapevine nutrient status, enhancing plant health, and supporting climate-resilient vineyard management.
- The study will benefit the table grape industry in identifying cover crops that improve grapevine health and sustainability.

Thank You!

❖ **FUNDING:**

- South Africa Table Grape Industry (SATI) and Agricultural Research Council (ARC) for funding Project P04000323.
- ARC and University of the Western Cape (UWC) for infrastructure and resources.
- SASEV for student grant support.

❖ **SUPERVISORS:**

- Prof Takalani Mulaudzi (UWC), Drs Reckson Mulidzi (ARC), Carolyn Howell (ARC), and Romeo Murovhi (ARC).

❖ **COLLEAGUES AND STAFF MEMBERS**:

- Soil and Water Science division, ARC Infruitec-Nietvoorbij.
- Members of SmartCrop Africa Research group, UWC.
- JDK Pty Ltd for permission to work in their vineyards, as well as their interest and technical assistance.