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# A case study about the use of precision agriculture technology applied to a Zn biofortification workflow for grapevine Vitis Vinifera cv Moscatel

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**Abstract:** As human population is growing worldwide, the food demand is sharply increasing. Following this assumption, strategies to enhance the food production are being explored, namely smart farming, for monitoring crops during the production cycle. In this study, a vineyard of *Vitis Vinifera* cv. Moscatel located in Palmela (N 38º 35' 47.113'' O 8º 40' 46.651) was submitted to a Zn biofortification workflow, through foliar application of zinc oxide (ZnO) or zinc sulfate (ZnSO$_4$) (respectively, at a concentration of 60% and 90% - 900g.ha$^{-1}$ and 1350g.ha$^{-1}$). The field morphology and vigor of the vineyard was performed through Unmanned Aerial Vehicles (UAV's) images (assessed with altimetric measurement sensors), synchronized by GPS. Drainage capacity and slopes showed 1/3 of the field with reduced surface drainage and a maximum variation of 0.80 m between the extremes (almost flat) respectively. The NDVI (Normalized Difference Vegetation Index) values reflected a greater vigor in treated grapes with treatment SZn90 showing a higher value. These data were interpolated with mineral content, monitored with atomic absorption analysis (showing a 1.3 fold increase for the biofortification index). It was concluded that the used technologies furnishes specific target information in real time about the crops production.

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# Materials and Methods

**Experimental Field**

Foliar application with $ZnSO_4$ and ZnO (0%, 60% and 90% - 0, 900 and 1350 g ha$^{-1}$)

**Field Morphology and vigor**

UAV's images

**Quantification of Zn**

Atomic absorption spectrophotometer

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# Results and Discussion

| Slope classes (%) | Surface Drainage | Area (m²) | % Area | | Moscatel variety | Zn (ppm) | | | NDVI | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | Mean | SE | | Treatment | Mean | SE |
| [0 – 5 %] | Reduced | 589.9 | 34.87 | | Control | 6.04a | ± 0.67 | | Control | 0.58 | 0.18 |
| ]5 – 20] | Moderate | 1080.5 | 63.86 | | OZn60 | 6.44a | ± 0.50 | | OZn60 | 0.61 | 0.16 |
| > 20 % | Elevated | 21.4 | 1.27 | | OZn90 | 7.91a | ± 0.28 | | OZn90 | 0.61 | 0.18 |
| | | | | | SZn60 | 6.58a | ± 0.65 | | SZn60 | 0.64 | 0.15 |
| Total | | 1691.8 | 100 | | SZn90 | 7.49a | ± 0.75 | | SZn90 | 0.64 | 0.14 |



NDVI (Lau Novo) (22.08.2019)

- The slopes of the experimental field were determined, being found a moderate surface drainage prevailing, with 63.86% of infiltration capacity.

- Zn contents in treated grapes showed, relatively to the control, 1.2 - 1.3 fold increases in the higher concentrations of treatments, OZn90 and SZn90 respectively.

- After the 4th treatment, Moscatel treated grapes revealed a positive response, showing higher NDVI values than the control, with treatments SZn displaying highest foliage densities.
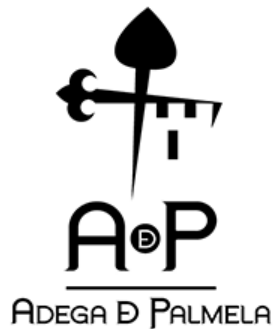
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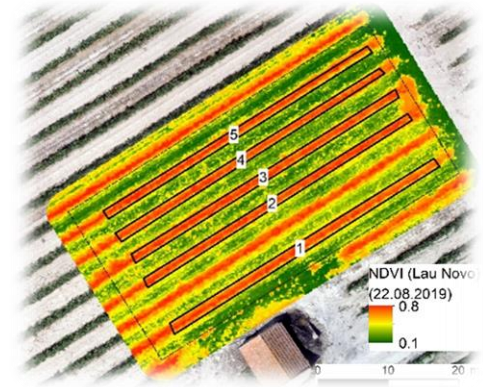
# Conclusions

- Through images obtained with cameras attached to UAV's, it's possible to get information about morphology of the field and potential limiting conditions for vines development.

- Using the Moscatel field as a test system, important characteristics, namely moderate infiltration capacity and the use of irrigation, enabling vines to have more resistance to hydric stress were optimized.

- The obtained images further gave information about the crops state, being detected a positive response to Zn fertilization with an increase in the Zn contents and vigor of vines subjected to ZnO and ZnSO4.

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