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A low cost approach for site-specific nitrogen application : a use case in viticulture

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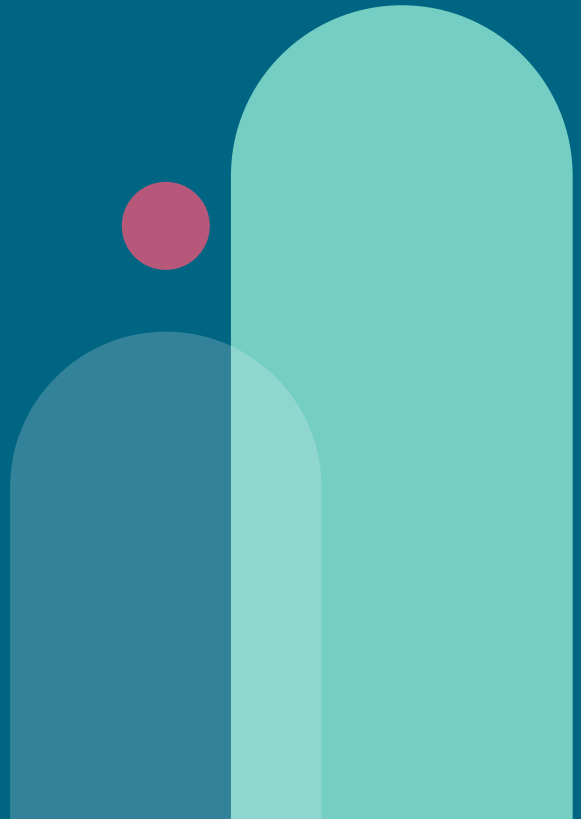
A low cost approach for site-specific nitrogen application : a use case in viticulture

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01

Introduction

Context, objectives



A mediterranean context

Location

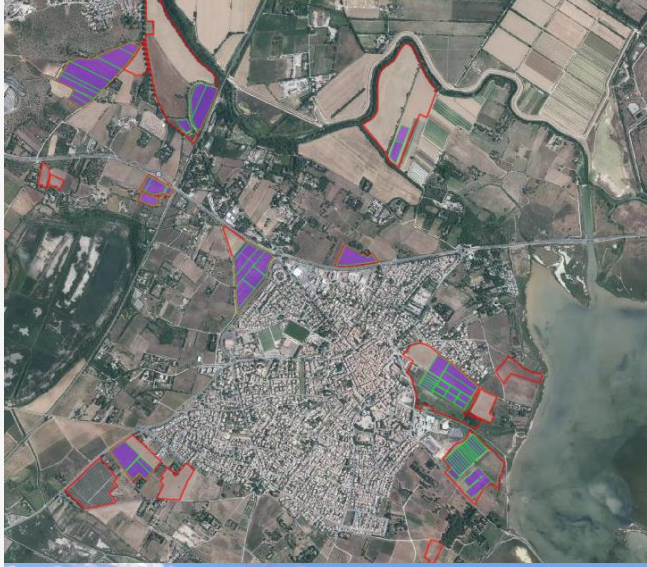
Villeneuve-Lès-Maguelone,
South of France

Operational context

30 ha, 51 blocks
Flat land, inter-row of 2.50m
Highly mecanized production

Economic situation

Structural crisis
Low product's value





Considering variable rate application (VRA) in viticulture

Potential benefits of VRA

Reducing variability in vine vigor, canopy density, grape composition overtime.

Low adoption of VRA

Not suitable for small-scale farms.
High cost and technical complexity.

Use of speed variation

Simplifying site-specific nitrogen application.
A low-cost & retrofit option.

Key questions

- What is the practical limit on the number of different speeds (corresponding to different fertilization rates) that can be effectively managed by the tractor driver?
- What data should be used and how should prescription maps be generated?
- How can clear and concise instructions be provided to the tractor driver to ensure accurate implementation of the variable speed application?
- How to ensure/verify that the speed prescriptions are actually properly applied by the tractor driver?

Testing a low cost approach for site-specific nitrogen application



Under routine conditions

Deployed on the whole vineyard
No operational adjustements required

Simple & cost effective

Using only available equipments.
No additional investments
Using speed variation

02

Materials & Methods

From data processing to validation of the method

Datasets available

Agronomic objective:

- Fertilize to compensate N exports based on previous harvesting yield
- Considering yield levels at a full potential

Starting point

2023 Low resolution yield map (Gras et al. 2024)

Other datasets

2023 Vine vigor map
2023 Missing stocks map

Co-creation of speed prescription maps

Defining prescribed speeds according to:

- Fertilization rules
- Yield variability
- Equipment (spreader settings)

Yield Variability	N dose	Prescribed speed
Estate's average yield 50 hl/ha (+/-15hl/ha)	30 units	7.5km/h
below the average yield (<30%)	22.5 units	10km/h
above the average yield (>30%)	45 units	5km/h

Co-creation of speed prescription maps

Designing speed zones, fine-tuned according to:

- Vine vigor heterogeneity
- Missing stocks areas
- Other field information/ qualitative datas

Built with free QGIS software and exported to standard shapefiles (.shp)



Use of a smartphone application for site-specific fertilization.

A tool to assist the driver during the operation:

- Easy-to-use app. for the driver
- Can be installed on any smartphone
- Supporting standard files (ie: shapefiles)
- Able to display: actual and prescribed speed, geolocation on the plot,…
- At a limited cost (280€/year; 10 to 50 ha)



Validation method of site-specific fertilization application.

- Dual-frequency GNSS geolocation tracking device
- Spatial analysis using free QGIS software
- Allowing comparison: actual average speeds against target speeds.



03

Results

Application of speed instructions

Application of speed instructions

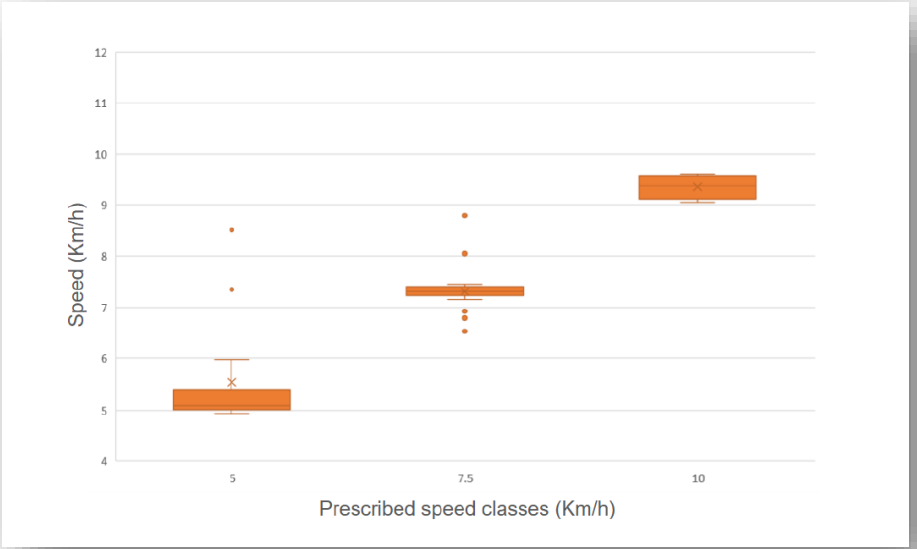




- Instructions have been generally applied
- Exceptions: zone transitions, end-of-row transitions, transport

Application of speed instructions

Prescribed speed
7.5km/h
10km/h
5km/h



- Considering margin error of 1.25 km/h
- Below the target speed for 7.5 km/h and 10 km/h
- N dose application was slightly higher than intended

Conclusions

VRA Fertilization

Applicable at intra-plot level with a low cost approach

Speed Instructions

Have been generally followed despite the use of basic equipment

Data & skills

Requires spatially referenced data and data processing skills

Driving constraints

Limit VRA precision (three different N application rates)

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