Grapevine in agroforestry: impact of evergreen trees on water stress, yield and grape composition

Marie Gosme, Deslandes Florent, Delmotte Sacha, Bouisson Yvan, Gary Christian, Mérot Anne, Dufour Lydie, Dupraz Christian

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Introduction

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Égalité
Fraternité

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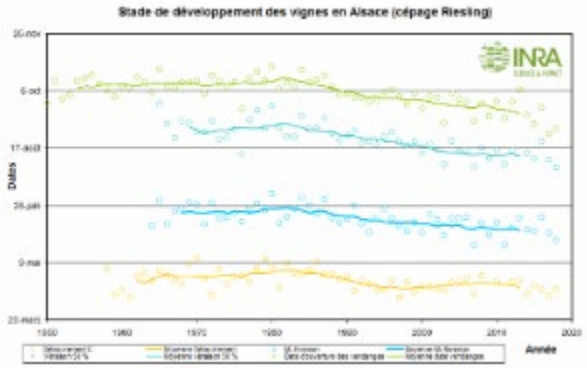
Introduction

Context

- The Mediterranean region is a hotspot for climate change
  - Increased temperatures in summer
  - decreased precipitation in summer
- Risks for grapevines
  - Heat waves
  - Drought
  - Spring frost
  - Maturation during warm temperatures



Crédits : INRAE, centre de Colmar

Introduction

Agroforestry as a way to adapt to climate change?

Daytime shade:
- reduces temperature
- reduces soil evaporation and crop transpiration

Night-time mask:
- reduces radiative cooling

Competition for light

Phenological delay of the crop
- lower risk of spring frost
- longer growing period

increased risk of terminal drought

Increased soil organic matter
- Increased field capacity

Deep tree roots
- Improved water infiltration
- Hydraulic lift

Competition for water
Competition for nutrients

=> Balance between positive and negative effects?

Material and methods

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Experimental site

- Restinclières, trees and grapevine planted in en 1996

- 2018

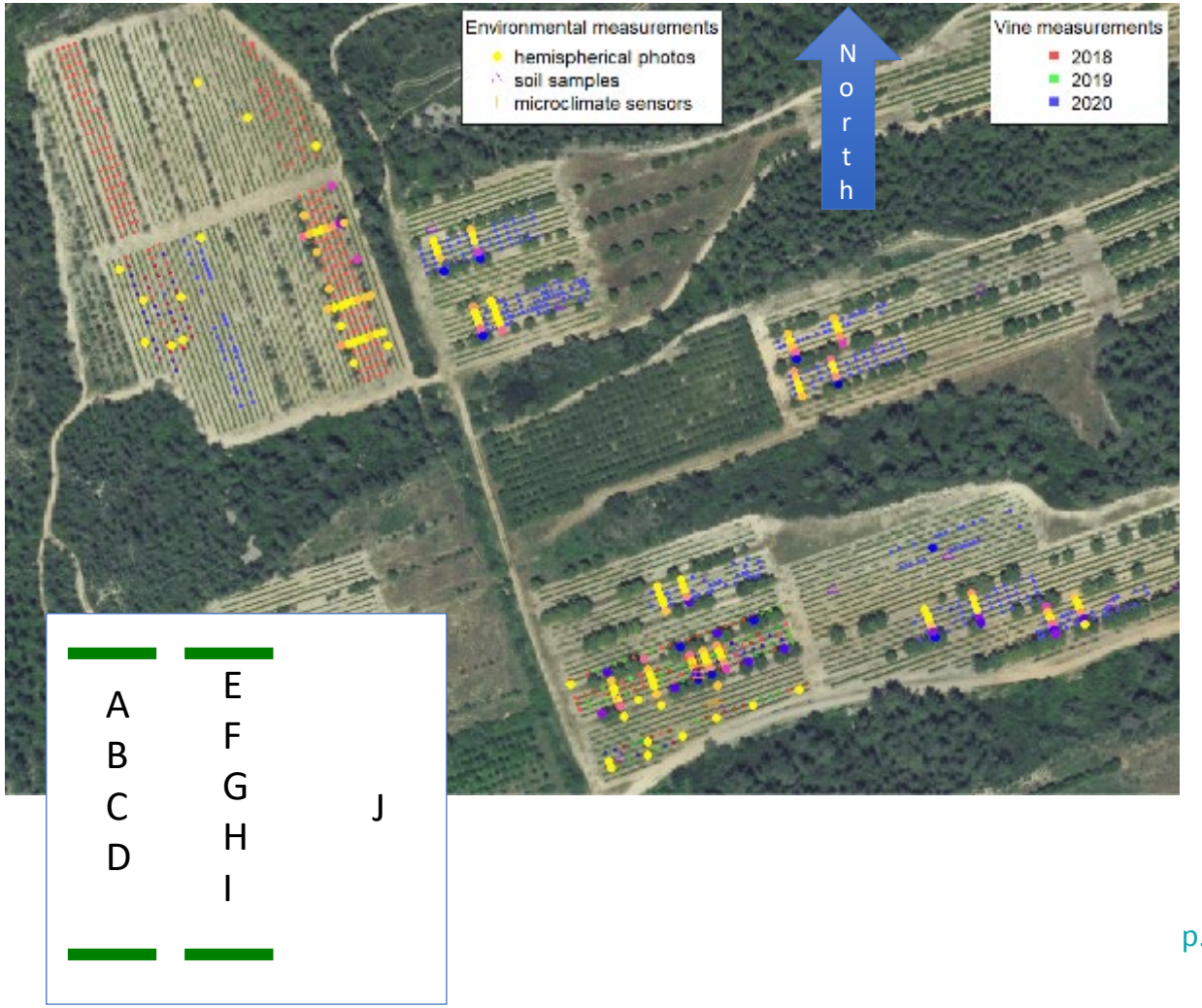
Field	modality	AF	PV	Total
B4N	Extensive	70	34	104
B4S	Intensive	87	38	125
B7W	Extensive	81	26	107
Total		**238**	**98**	**336**

- 2019

Field	modality	AF	PV	Total
B7W	Extensive	80	27	107

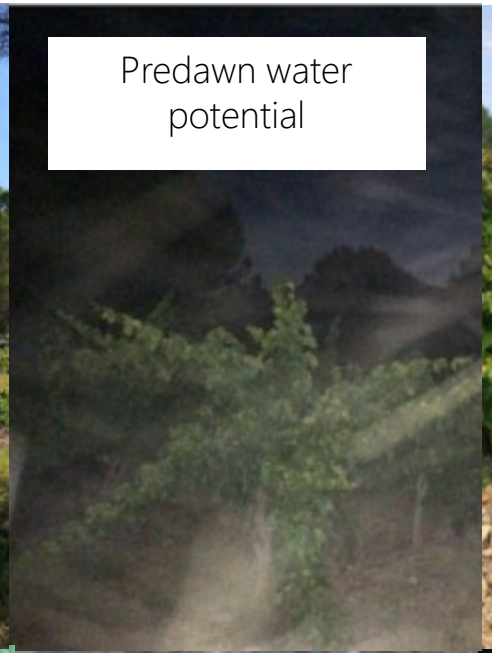
- 2020

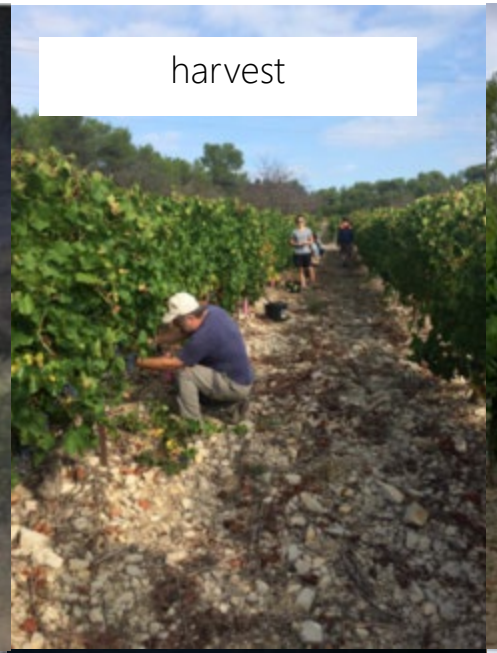
Field	System	modality	Grenache	Syrah	Total
B4S	PV	-	36	32	68
B5	AF	Intensive	54	68	122
B6	AF	Extensive	45	22	67
B7E	AF	Intensive	47	35	82
	PV	-		24	24
B7W	AF	Extensive	34	37	71
	PV	-	24		24
Total			**240**	**218**	**458**



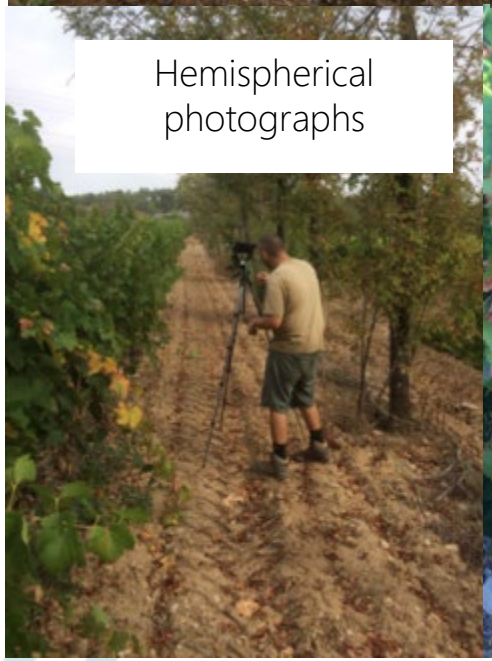

microclimate


phenology

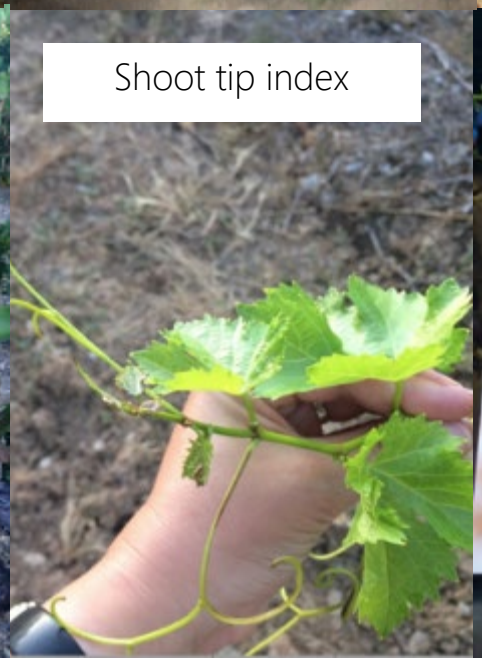

Predawn water potential

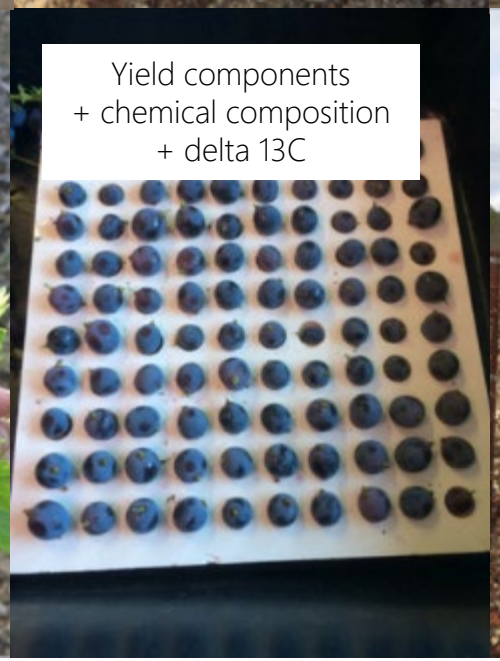

harvest


Soil texture


Hemispherical photographs


diseases


Shoot tip index


Yield components
+ chemical composition
+ delta 13C


Vegetative vigor

Results

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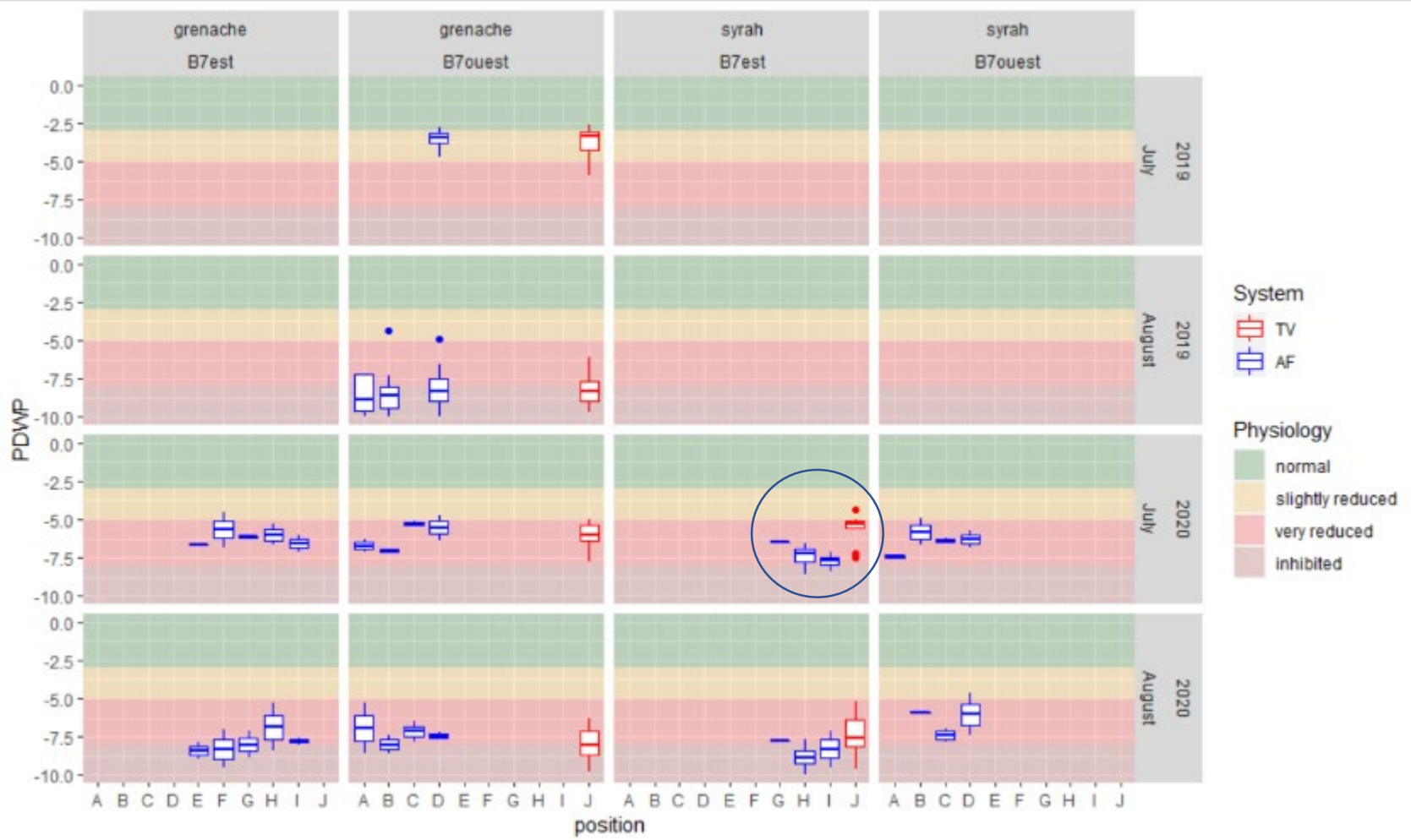
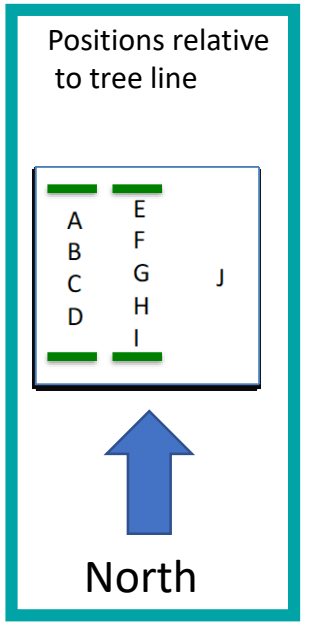
Results

Soil water (pre-dawn water potential)

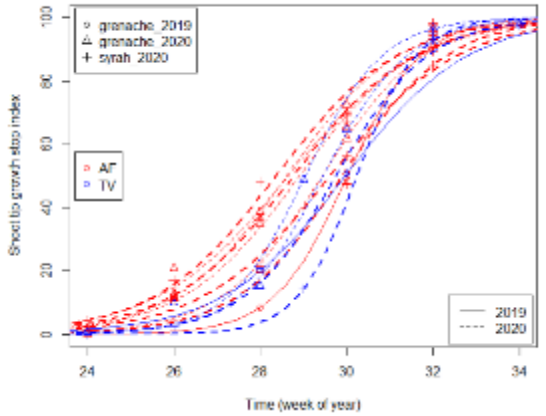


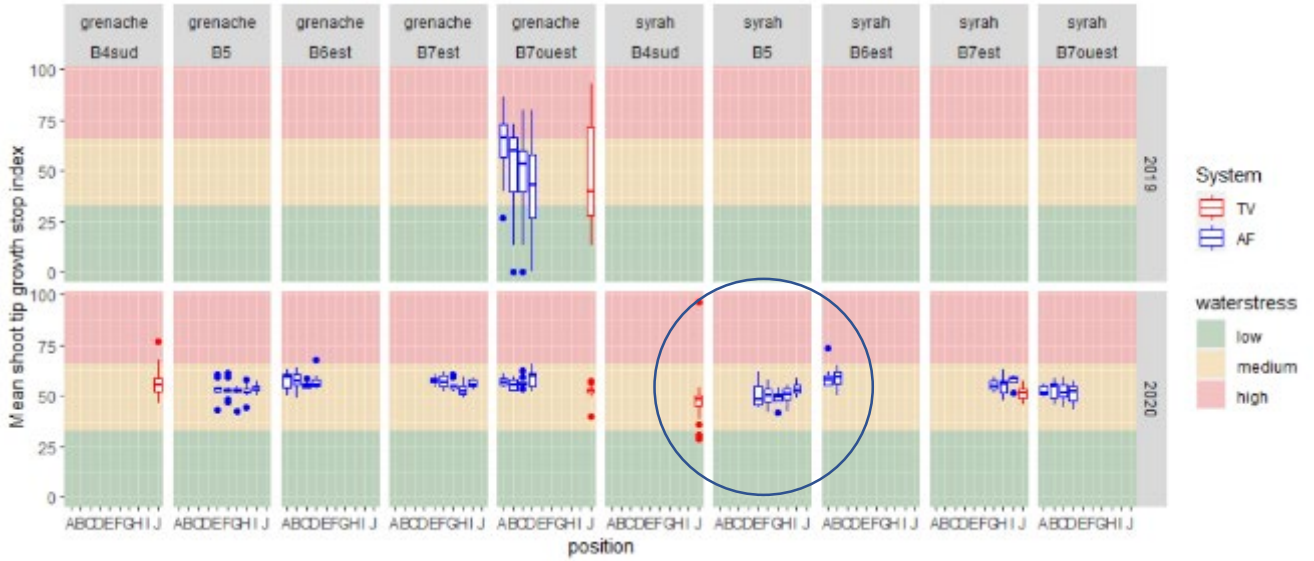


=> No effect of trees on soil water, except in plot B7est in July 2020 (drier soil in AF than PV)

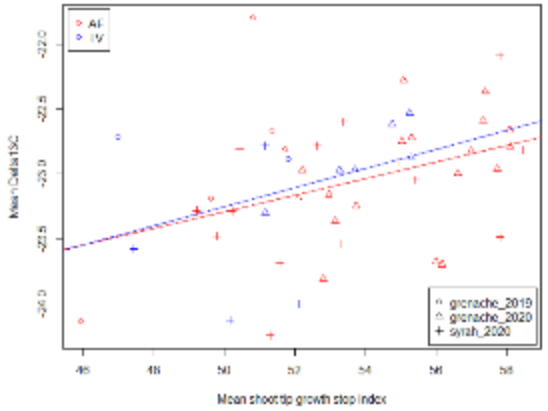
Results

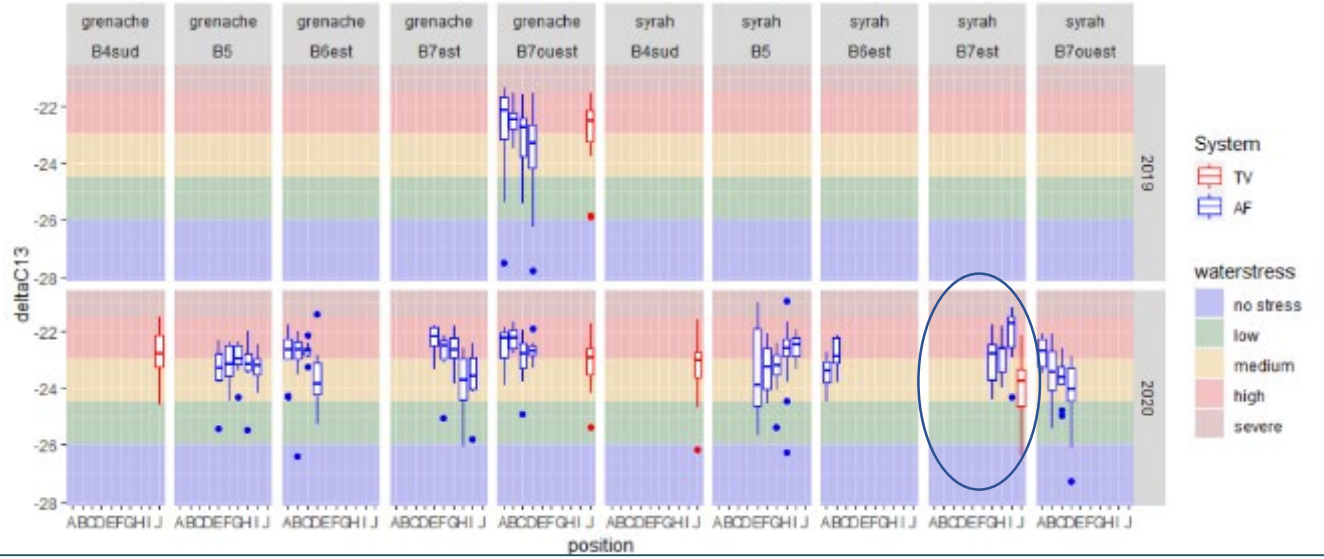
Shoot tip growth stop index

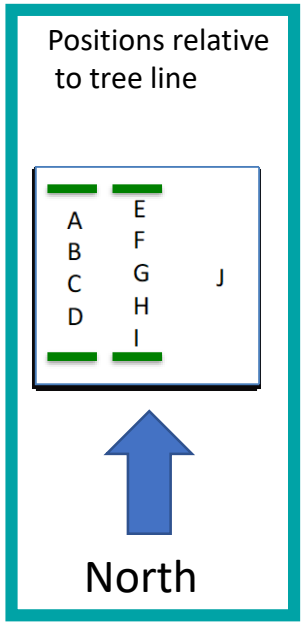




Delta ^{13}C





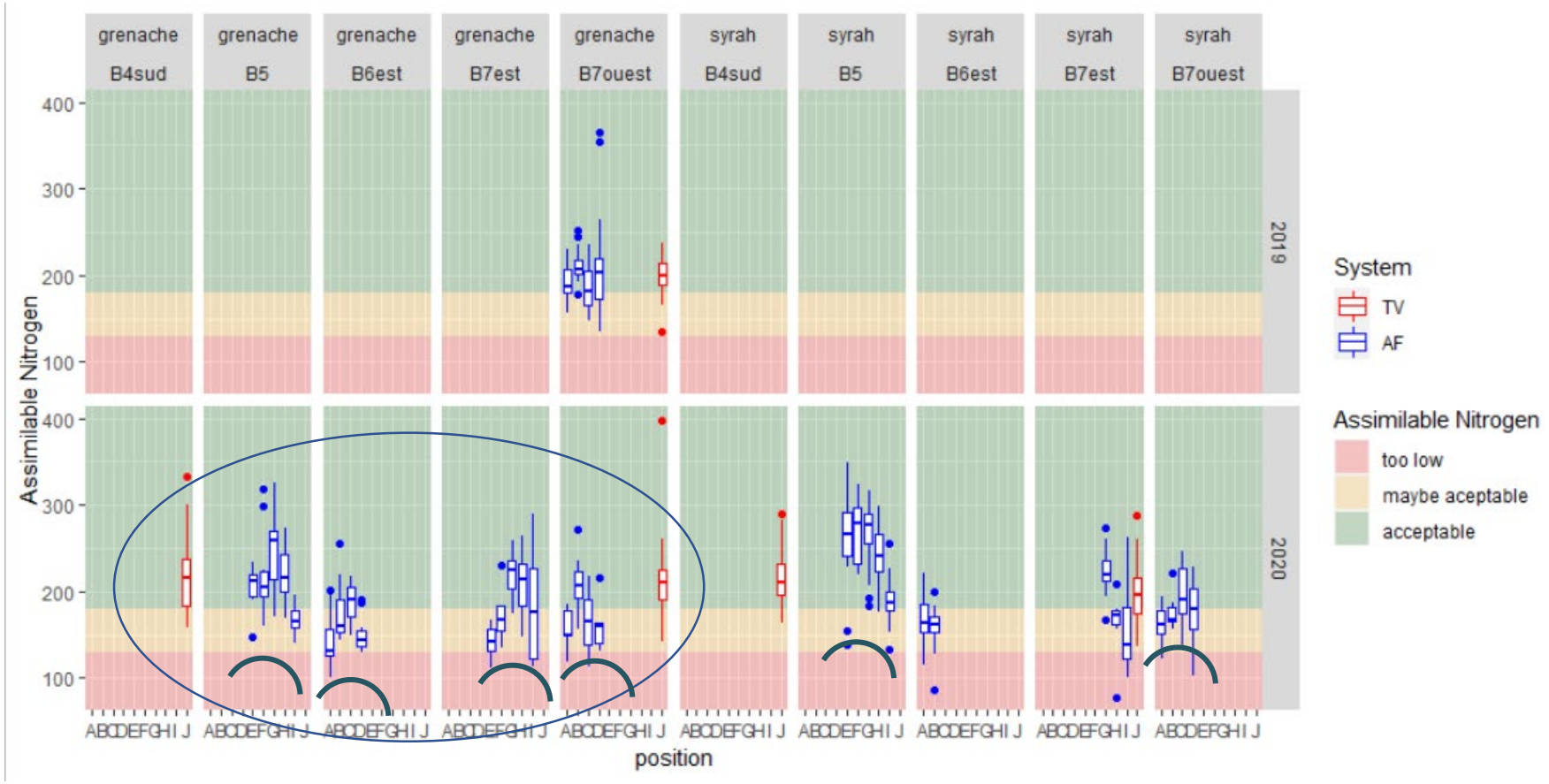


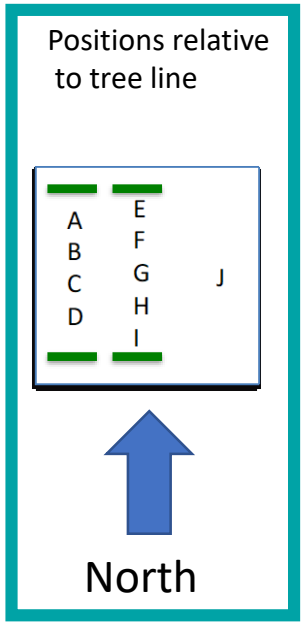
NB: the correlation between the 2 stress indicators is not so good

=> No effect of trees on water stress, except in some plots for Syrah in 2020 (more stress in AF than PV)

Results

Assimilable Nitrogen

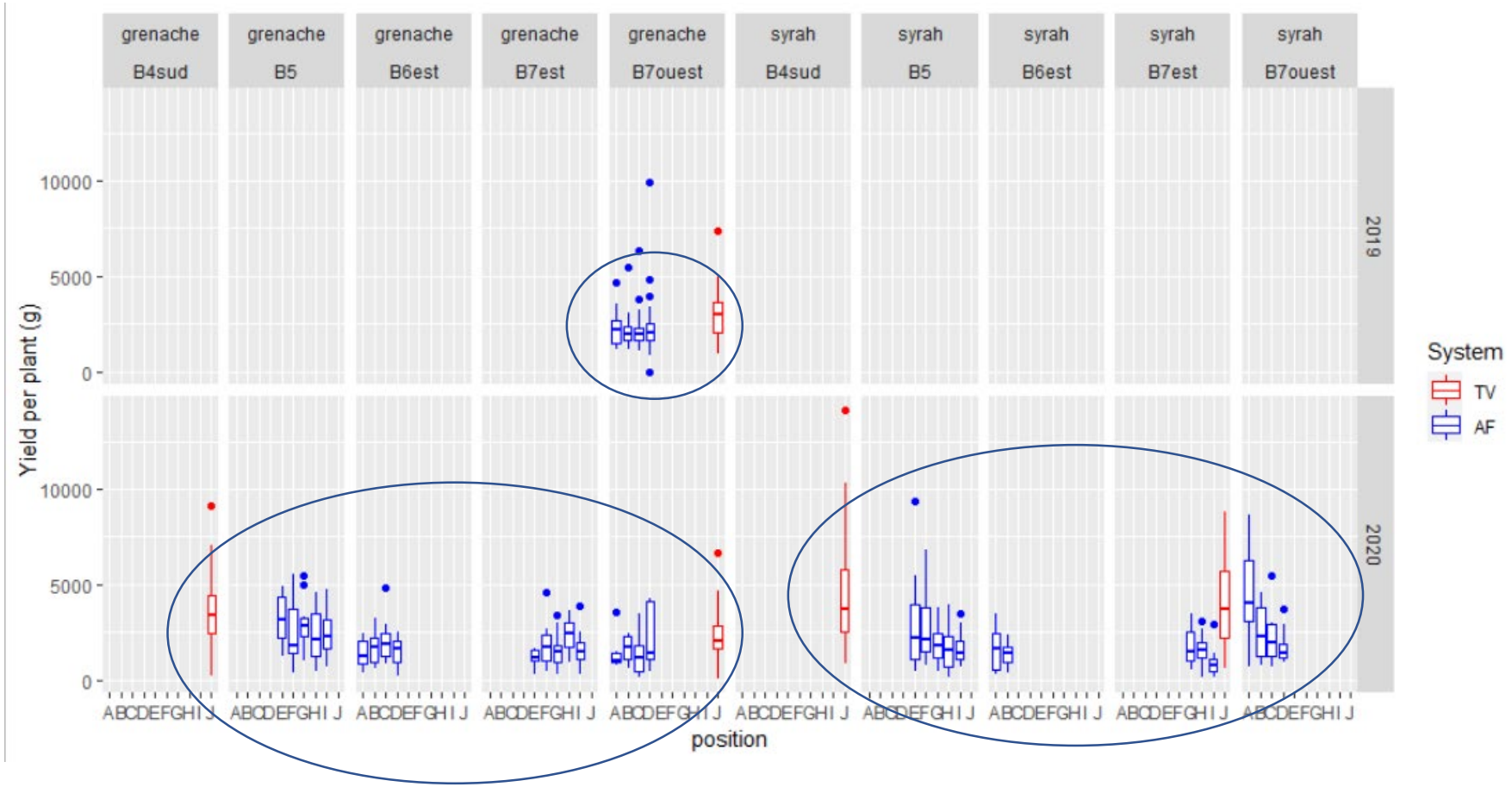


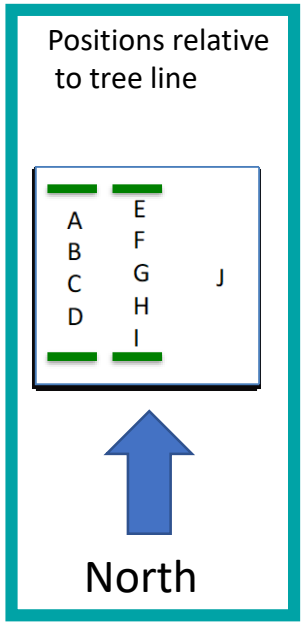


=> Nitrogen competition for Grenache in 2020, but not in 2019 and not for Syrah

Results

Yield per plant





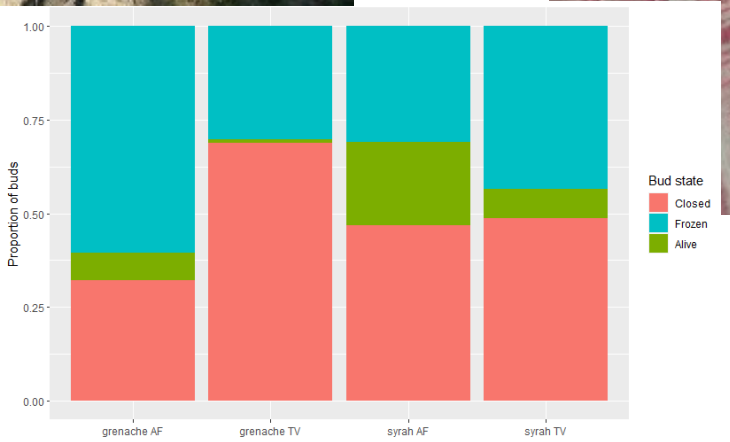
=> Reduction of yield per plant in AF compared to PV

Results

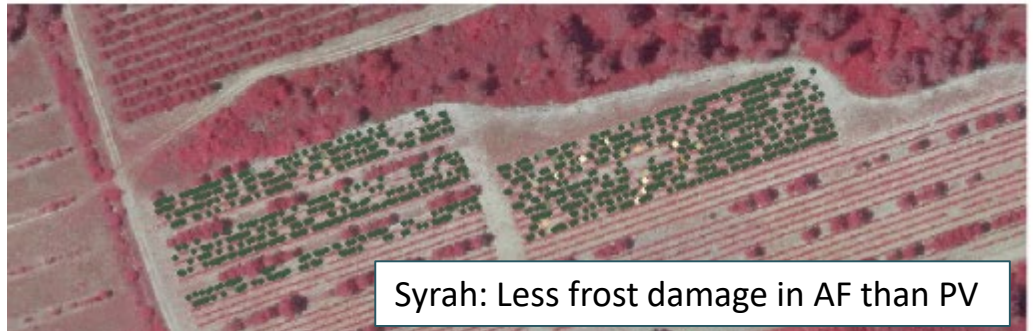
Protection against frost damage

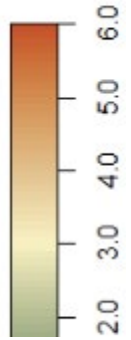
2017

2021

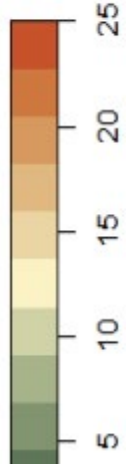


Frost damage April 2017





Frost damage April 2021

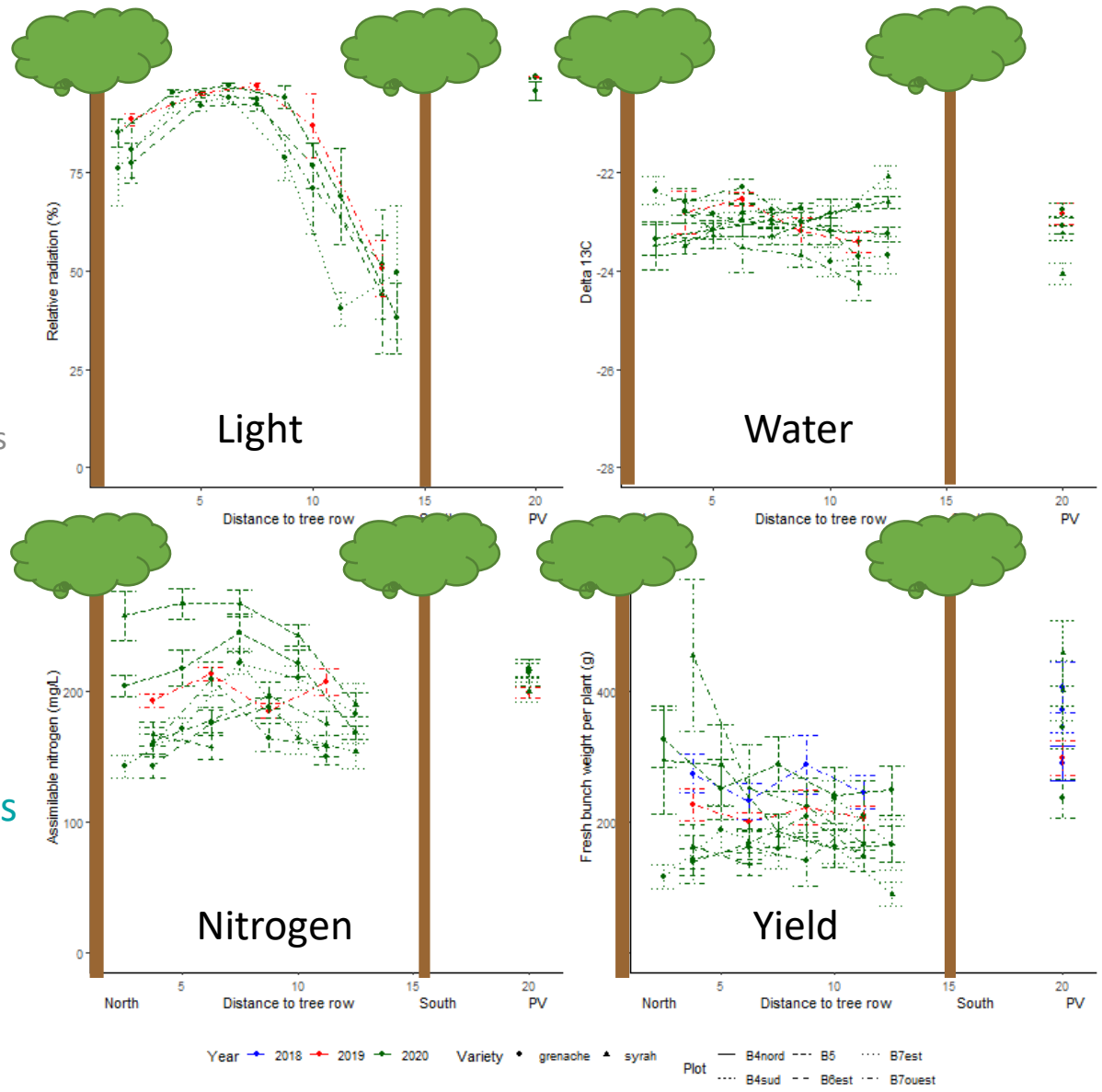


Grenache: less frost damage among open buds in AF then TV, but more open buds in AF
Syrah: Less frost damage in AF than PV

Take-home messages

Yes, there is protection against frost but…

- Solar Radiation
  - -21% in AF over the whole season/across the whole transect
- Water stress
  - No systematic effect
- Assimilable Nitrogen
  - There seems to be a trend for less nitrogen near the trees
- Yield per plant
  - Grenache variety:
    - 34% in 2018
    - 36,7% in 2019
    - 33,8% in 2020
  - Syrah variety: -55,3 % in 2020
- Protection against frost/heat wave would have to be very effective to compensate for yield loss
- It might be possible to adapt grapewine management/varieties for AF conditions?



Acknowledgments

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