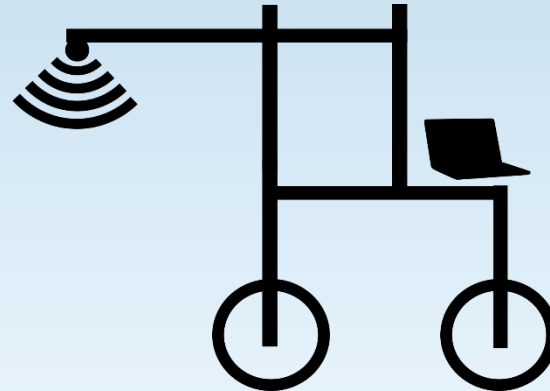


ASSESSMENT OF THE IMPACT ON WHEAT YIELD OF THE INTERACTION BETWEEN FERTILIZATION AND YELLOW RUST THROUGH MULTI-SENSORS MACHINE VISION

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This study is funded by the Walloon Region : FRIA grant + project D31-1385 « PhenWheat »



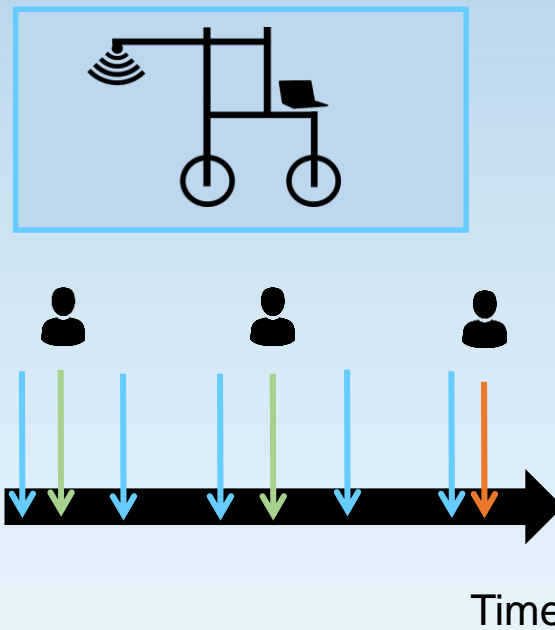
Wheat trials are evaluated according to :



A few manual measurements



Yield





Trial field



- *Location* : Gembloux (Belgium)
- *Variety* : KWS Smart
- *Previous crop* : Spinach
- *Sowing* : 2018-10-23

Fungicide modalities

No fungicide

At BBCH 39

At BBCH 32, 39, 65



Fertilization (kgN/ha)

Inputs at BBCH 28-30-39

Moderated	40-30-30
Classic	60-50-50
Excess	100-80-80



3





Expert scoring of disease

Score depends on :

- Foliar floor affected
- Disease intensity
- Repartition in the micro-plot (12 m²)



		Affected leaves											
		F4 and inferior leaves			F 3			F 2			F 1		
Average intensity		low	medium	high	low	medium	high	low	medium	high	low	medium	high
Repartition	< 3 plants	9	9	9	9	9	9	9	9	9	9	9	9
	< 10 plants	8	8	8	8	8	8	8	8	8	8	8	8
	10<X<50 plants	8	8	8	8	8	8	7	7	7	6	6	6
	1 in 10 plants	8	8	7	7	7	6	6	5	4	4	3	2
	1 in 2 plants	8	8	7	7	6	6	5	4	4	3	2	2
	all the plants	8	8	7	7	6	5	5	4	3	3	2	1
	all the leaves	7	7	6	6	5	5	4	3	3	2	1	1



5



Color
camera



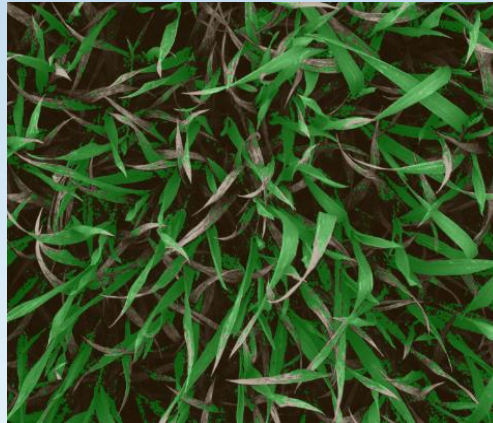
Multispectral
camera array

- 4 images / plot
- Camera 1 m above canopy
- JAI USB GO-5000 camera
- Tetracam Micro-MCA6





Color image



Green surface

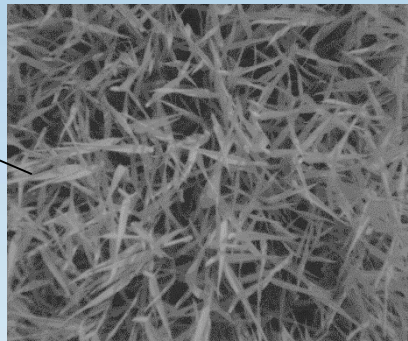


% of green

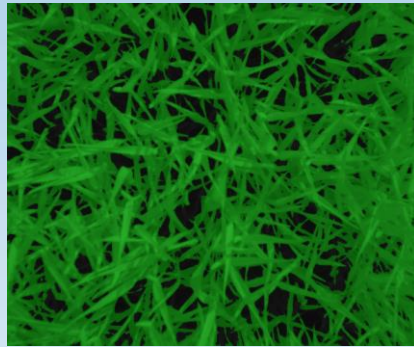




8



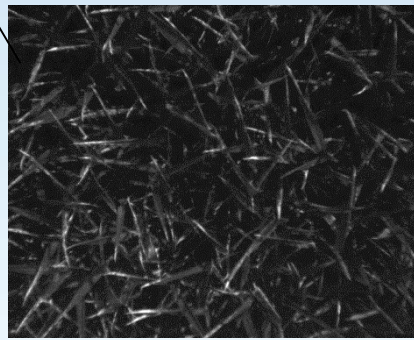
Near infra-Red 800 nm



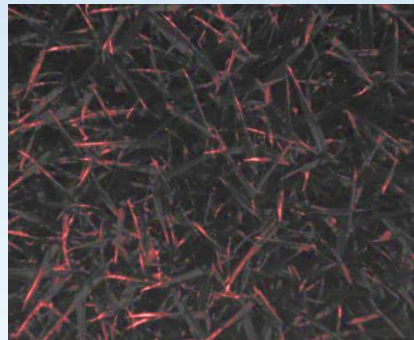
Plant surface



% of plants



Red 680 nm



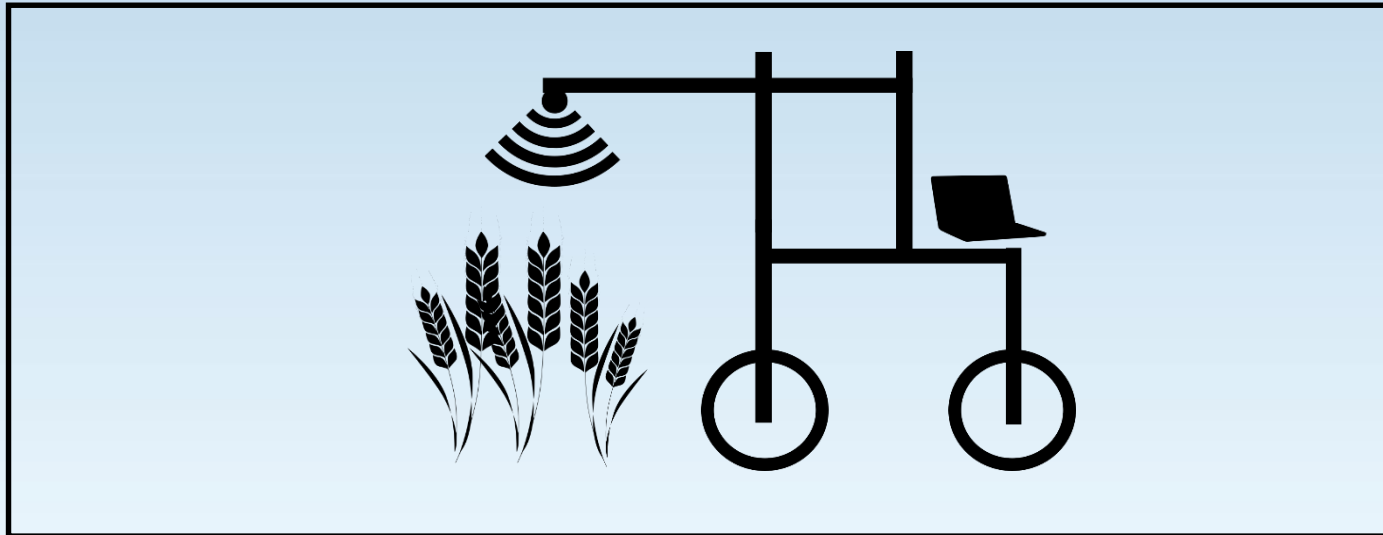
Damage

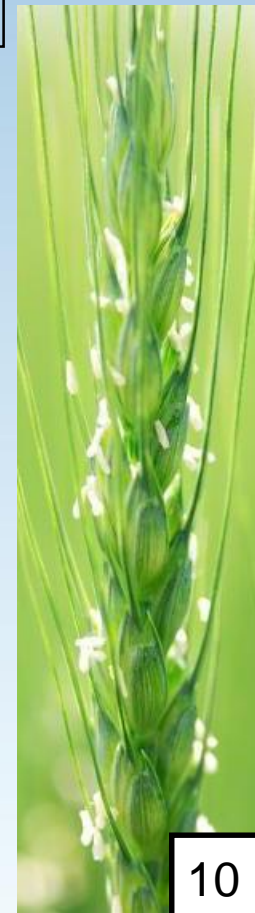
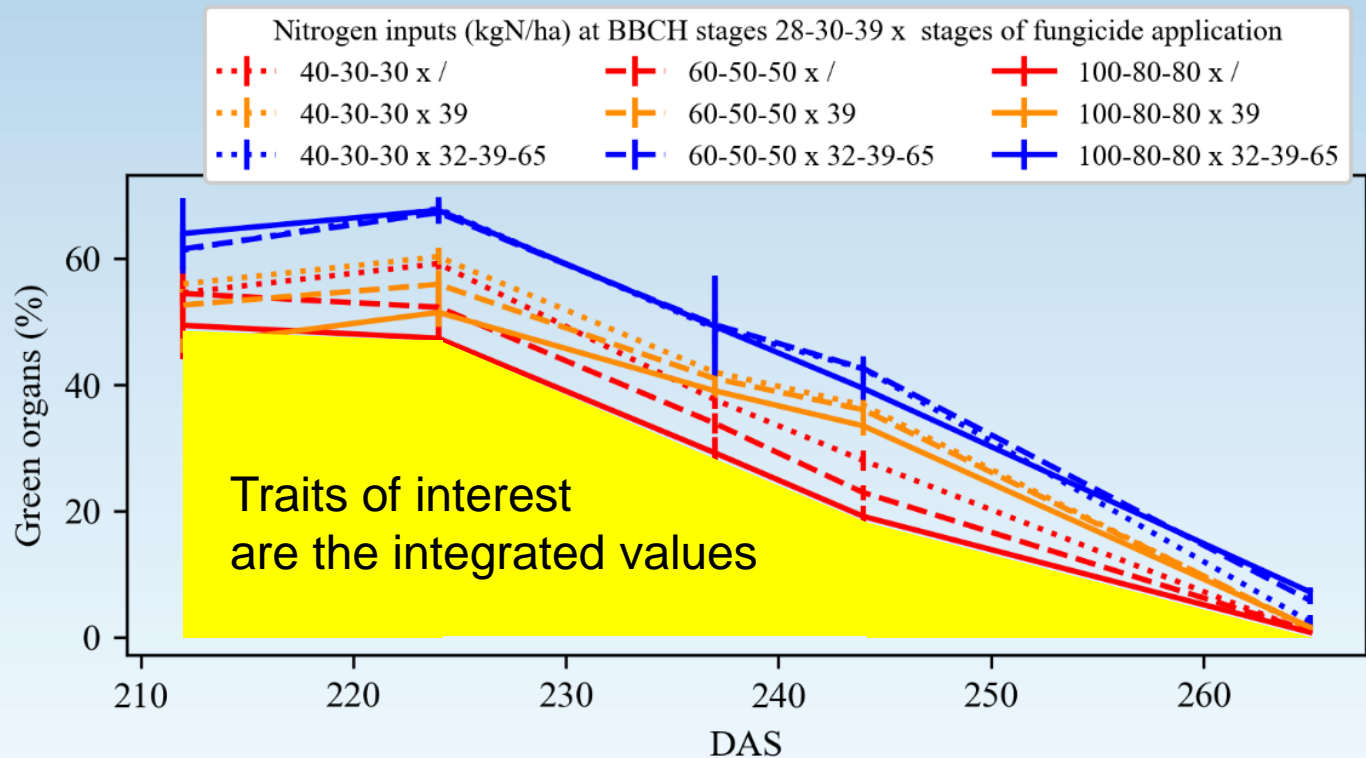


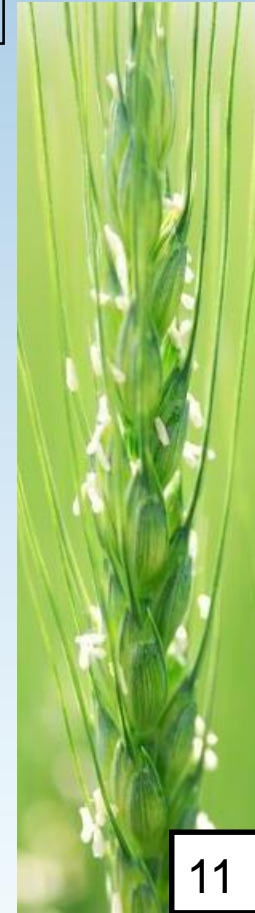
% of damage



I. FUNGI X FERTI : IMPACT ON YIELD







Correlation matrix

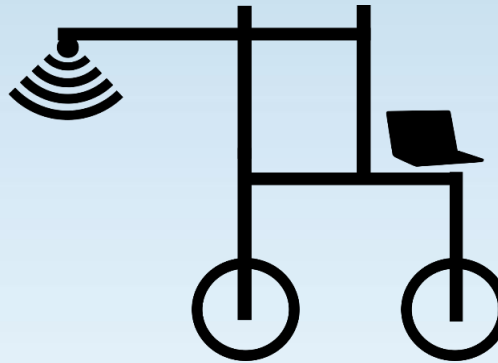




II. YELLOW RUST SCORING



VS



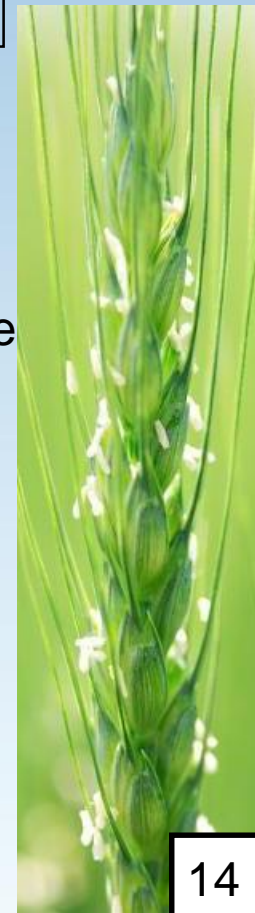
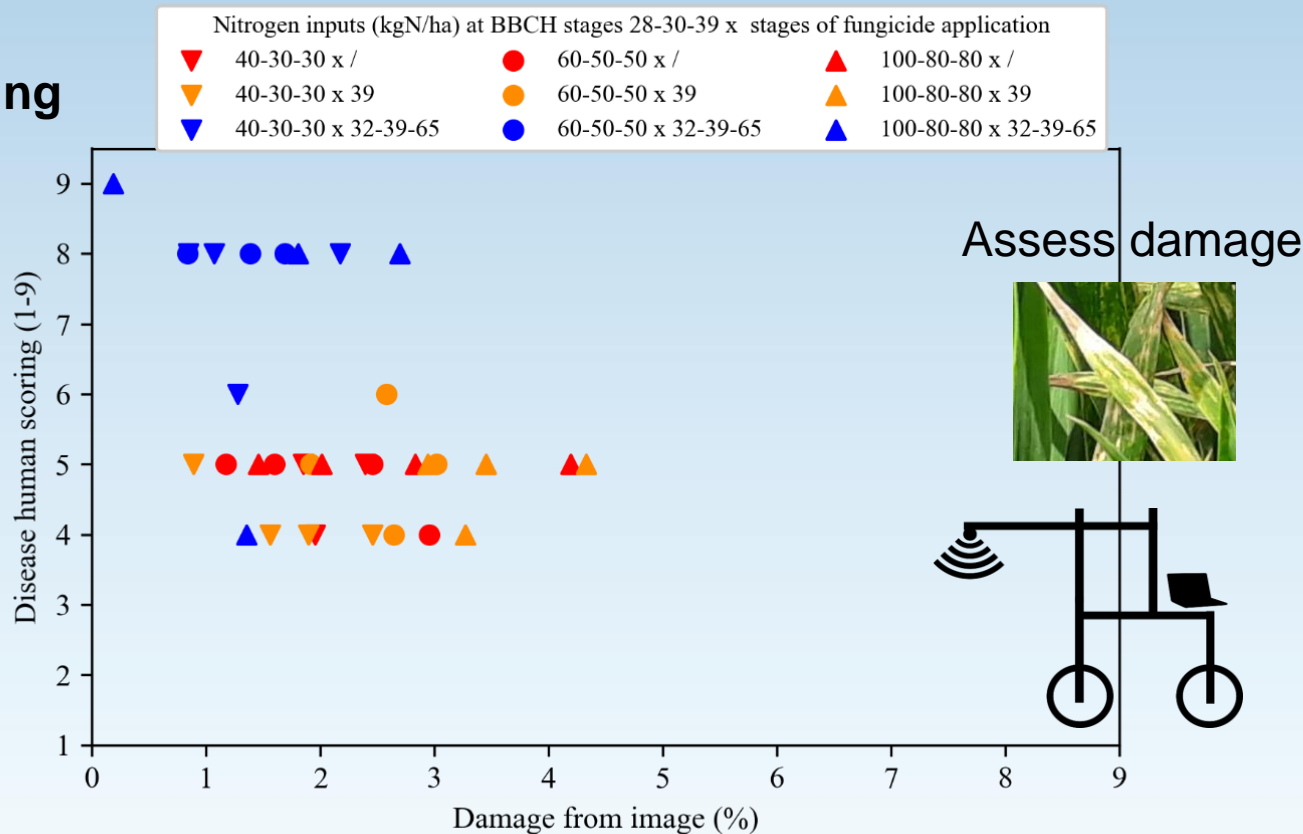
13



212 DAS
Before spraying
at BBCH 39



Assess spores



14



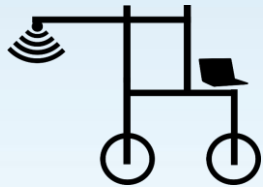
Interest of close-range imaging tool to follow crop dynamics



Need a wider frame to perform robust studies : embed measured traits
In FAIR data bases along with environmental and management data



Complementarity of experts and machines. Experts assess the
presence of spores (the cause) while machines quantify leaf damage
(the consequence)



Thank you for your attention

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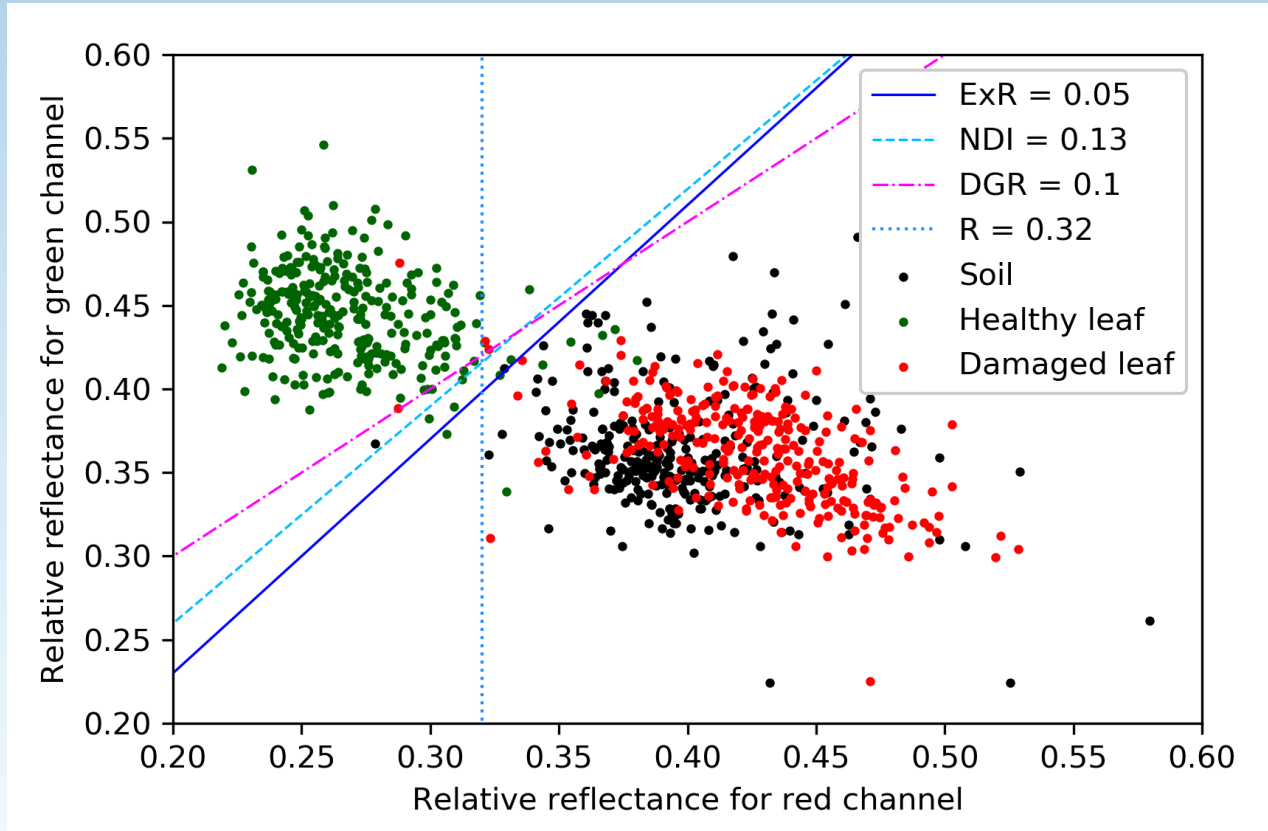


Related researches

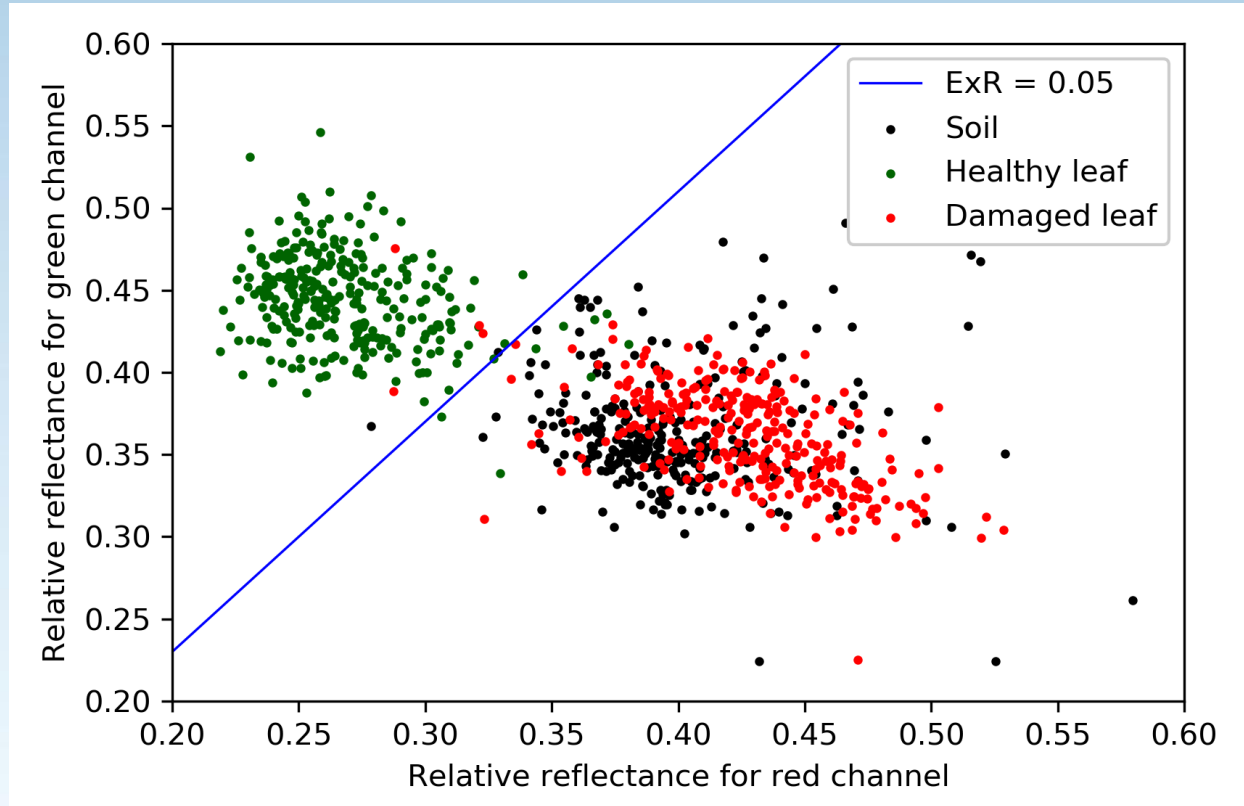
Bebronne, R., Carlier, A., Meurs, R., Leemans, V., Vermeulen, P., Dumont, B., & Mercatoris, B. (2020). In-field proximal sensing of septoria tritici blotch, stripe rust and brown rust in winter wheat by means of reflectance and textural features from multispectral imagery. *Biosystems Engineering*, 197, 257–269. <https://doi.org/10.1016/j.biosystemseng.2020.06.011>

Dandrifosse, S., Bouvry, A., Leemans, V., Dumont, B., & Mercatoris, B. (2020). Imaging wheat canopy through stereo vision: overcoming the challenges of the laboratory to field transition for morphological features extraction. *Frontiers in Plant Science*, 11(February), 1–15. <https://doi.org/10.3389/fpls.2020.00096>

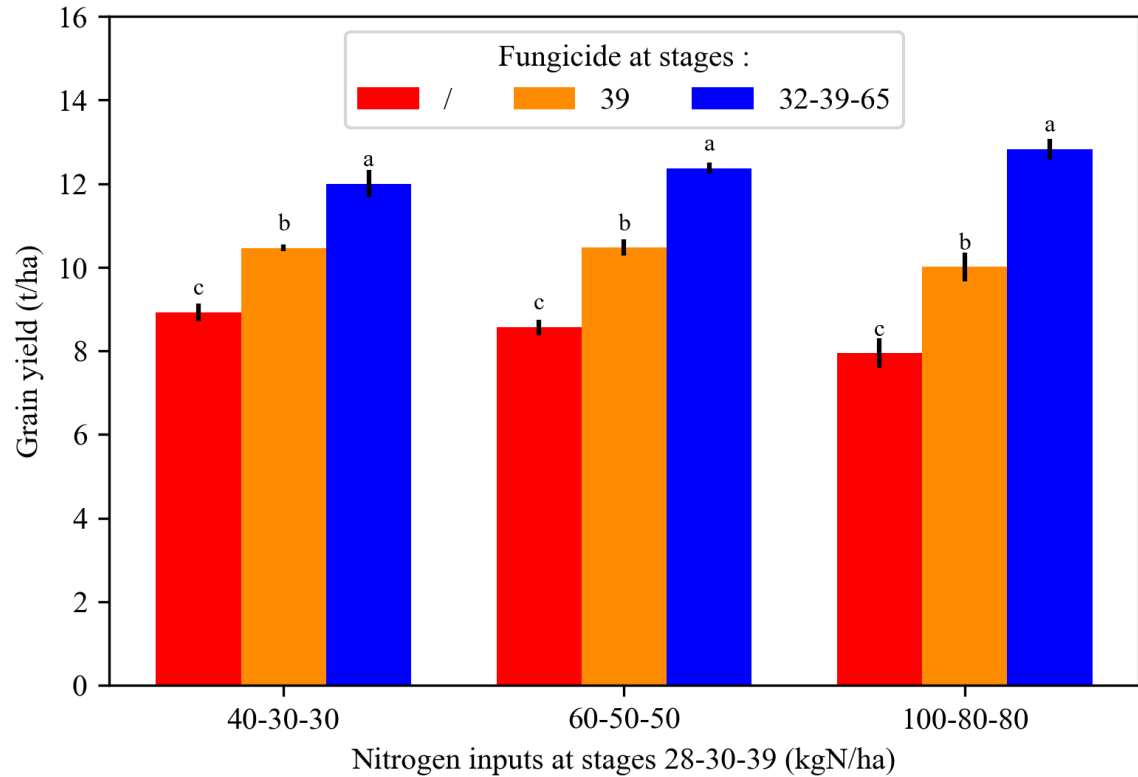
Segmentation of RGB images

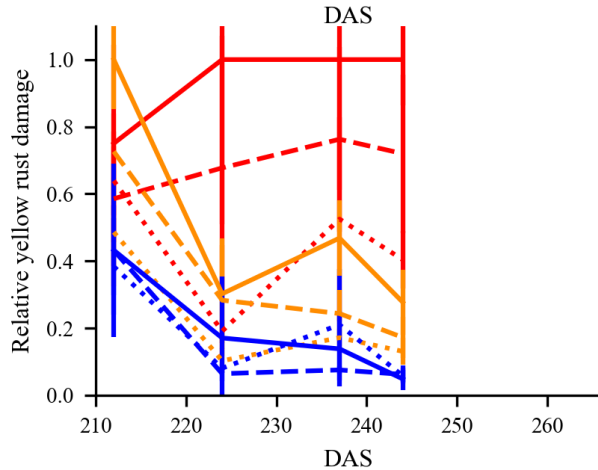
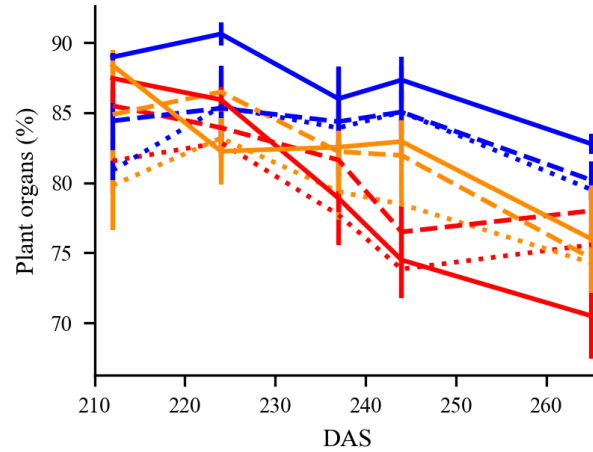
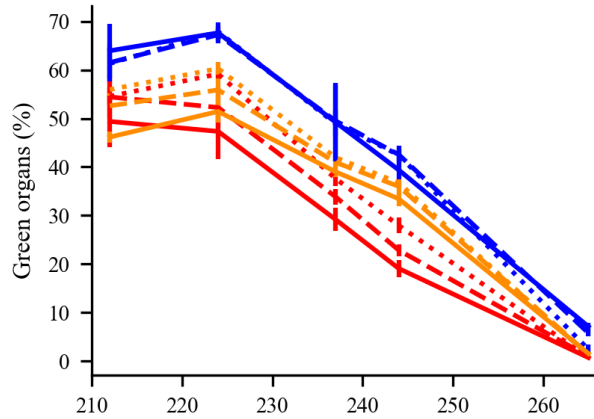


Segmentation of RGB images



ANOVA and Tukey test

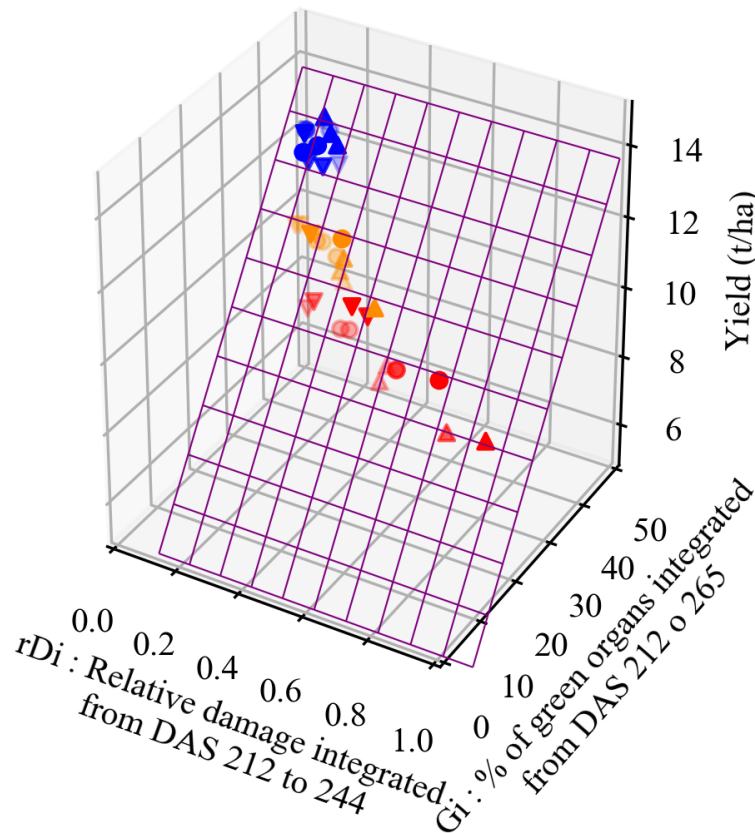




Nitrogen inputs at stages 28-30-39 (kgN/ha)
x Stages of fungicide application

- 40-30-30 x /
- 40-30-30 x 39
- 40-30-30 x 32-39-65
- 60-50-50 x /
- 60-50-50 x 39
- 60-50-50 x 32-39-65
- 100-80-80 x /
- 100-80-80 x 39
- 100-80-80 x 32-39-65

Bivariate model



- ▼ 40-30-30 x /
 - ▼ 40-30-30 x 39
 - ▼ 40-30-30 x 32-39-65
 - 60-50-50 x /
 - 60-50-50 x 39
 - 60-50-50 x 32-39-65
 - ▲ 100-80-80 x /
 - ▲ 100-80-80 x 39
 - ▲ 100-80-80 x 32-39-65
- Yield = $0.83 + -0.02 * rDi + 0.26 * Gi$
Validation : $R^2 = 0.87$, RMSE = 0.55