School of Agriculture, Policy and Development

University of Reading

Real-time spatial quantification of grain quality

John Hammond
j.p.hammond@reading.ac.uk

2021 Annual DEFRA OREGIN stakeholder forum 23 November 2021

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Co-funded by the European Union

Overview

- Overview of NIRS
- Development of a ruggedised NIRS capability
- In field testing
- Where next

Yield mapping is now common

- Provides great understanding of within field variability
- Opportunities to adjust subsequent management options

Can we extend this to quality?

- Improved link to management, in particular N
- Potential in the future to separate grain based on quality

NIRS is a well established, robust method for grain quality assessment

- Rapid
- Range of gain and quality parameters
- Accurate?
- No sample prep

- But…
- Typically lab based technology

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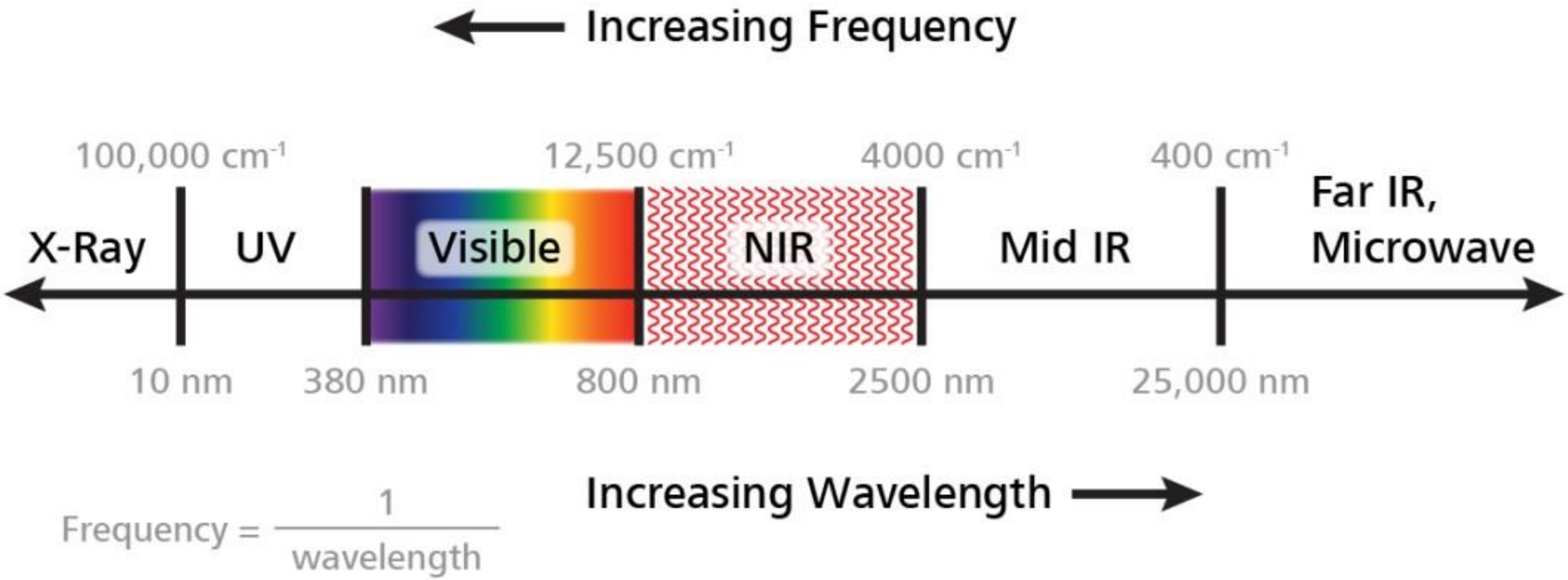
NIR fundamental principles



$$\text{Frequency} = \frac{1}{\text{wavelength}}$$

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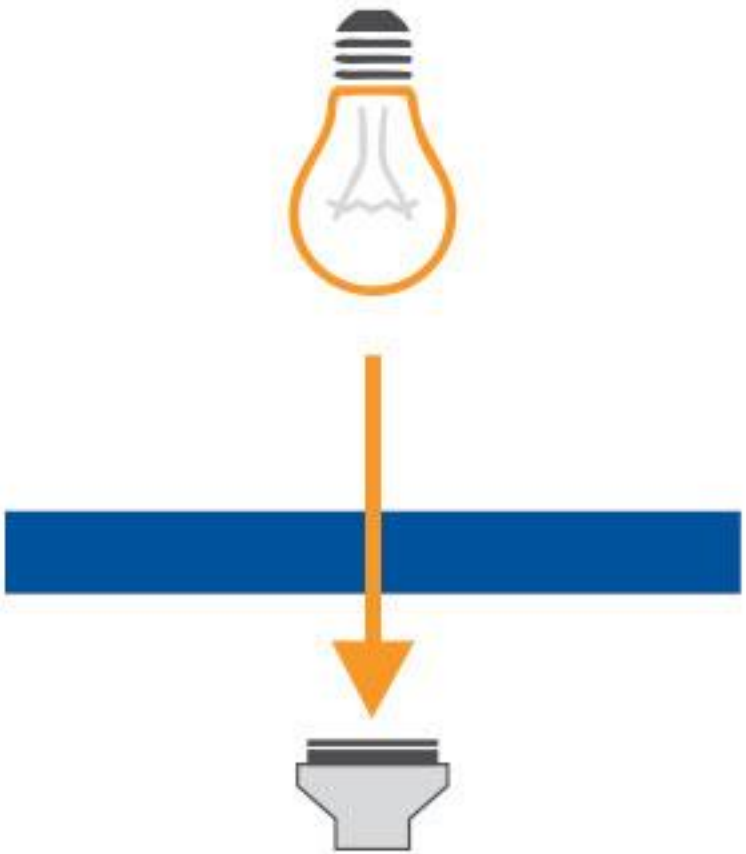
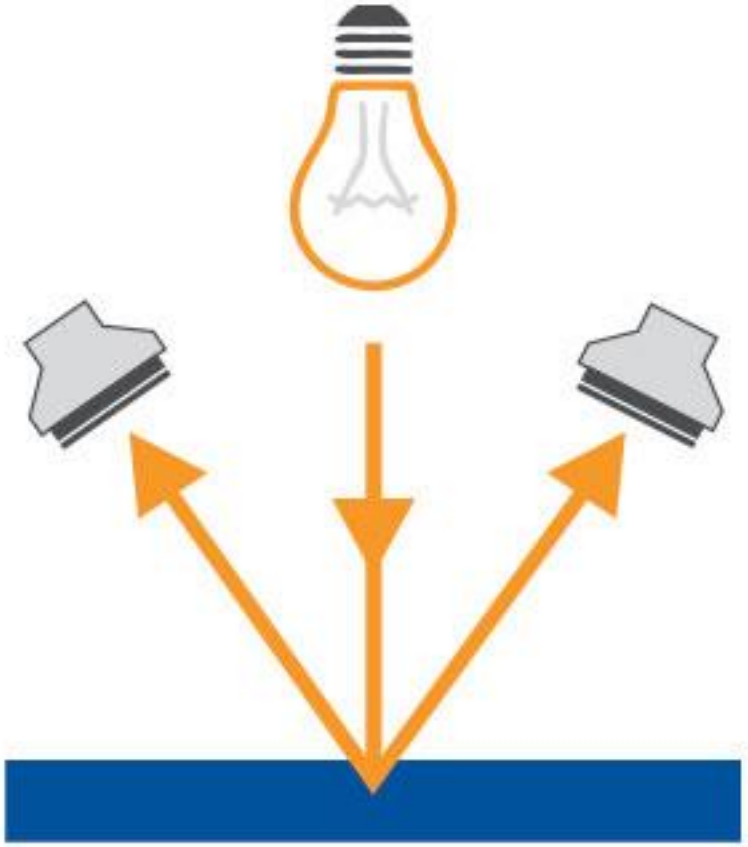
NIR fundamental principles



Transmission

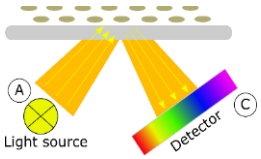


Reflectance

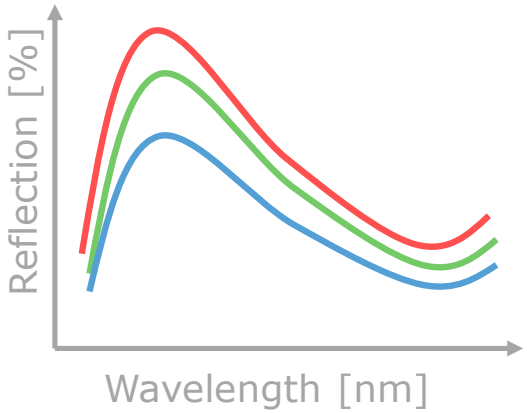
NIR fundamental principles

Quality parameters are predicted from the optical response of the material (Spectrum).

Sensor



Spectra



Predictions

e.g. Moisture

- High
- Medium
- Low

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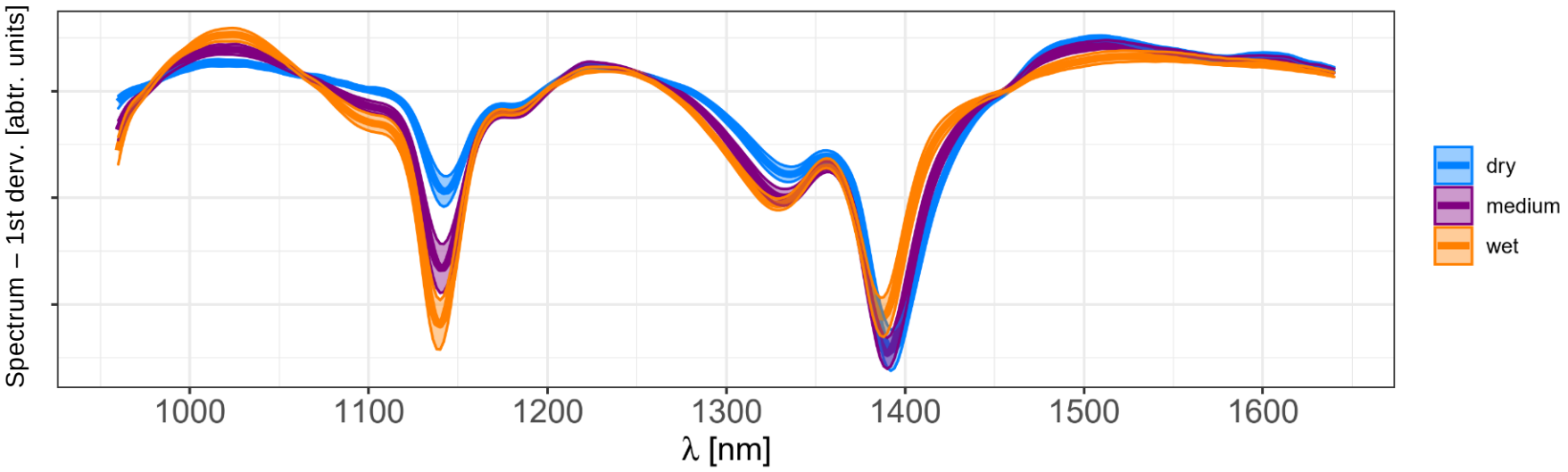
Example: Spectra of wheat



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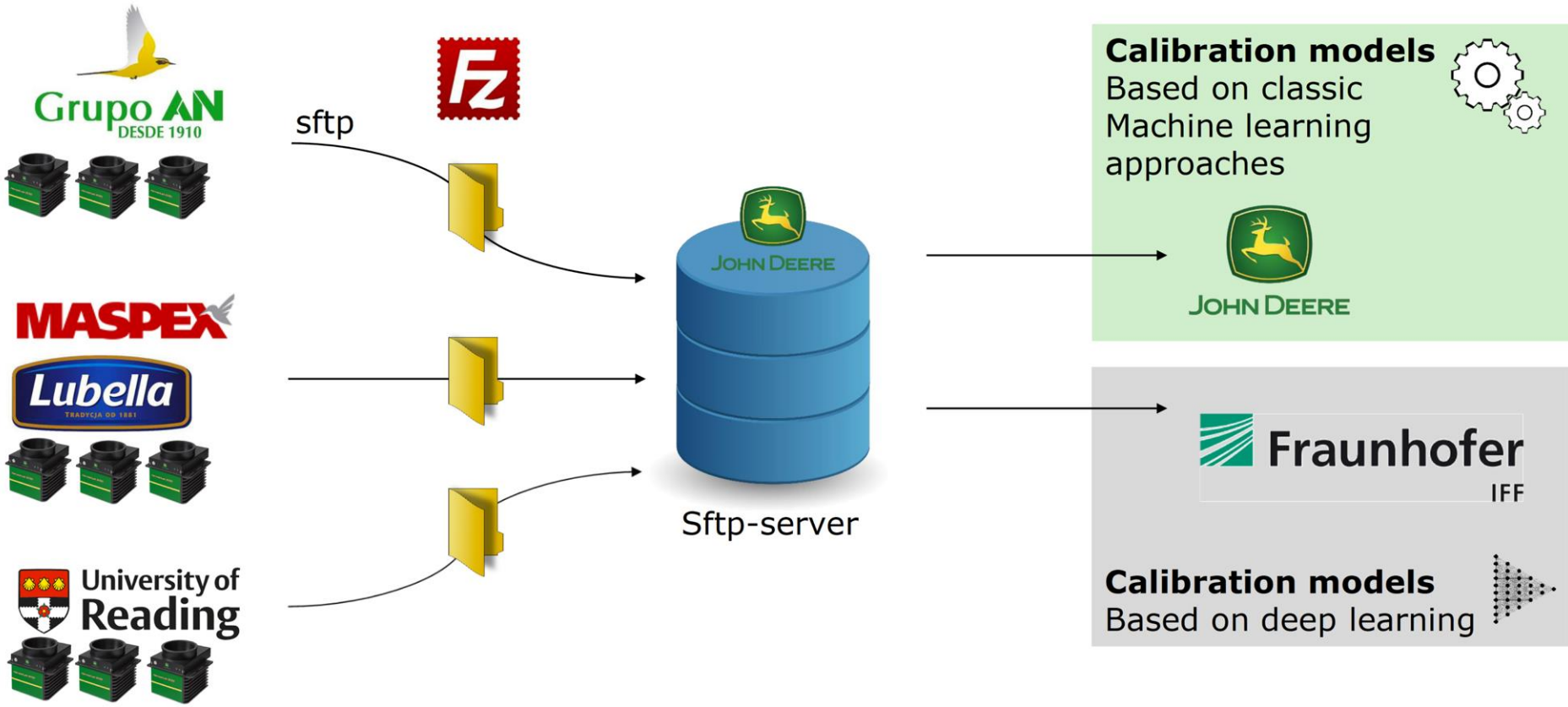
Constituent Sensing of Small Grains

Field Testing



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Constituent Sensing of Small Grains

Knowledge of constituents → utilization/trading based on quality

Moisture?
Protein?
Starch?
Oil?

- Mill
- Malthouse
- BioGas
- Forage

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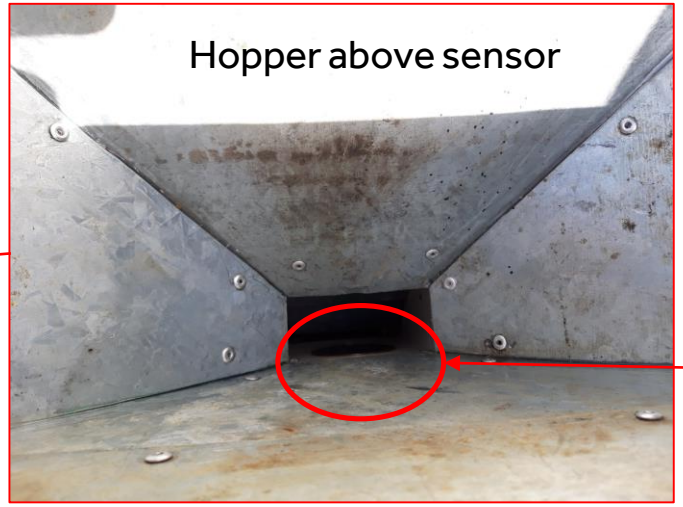
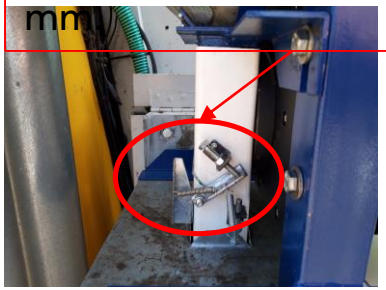
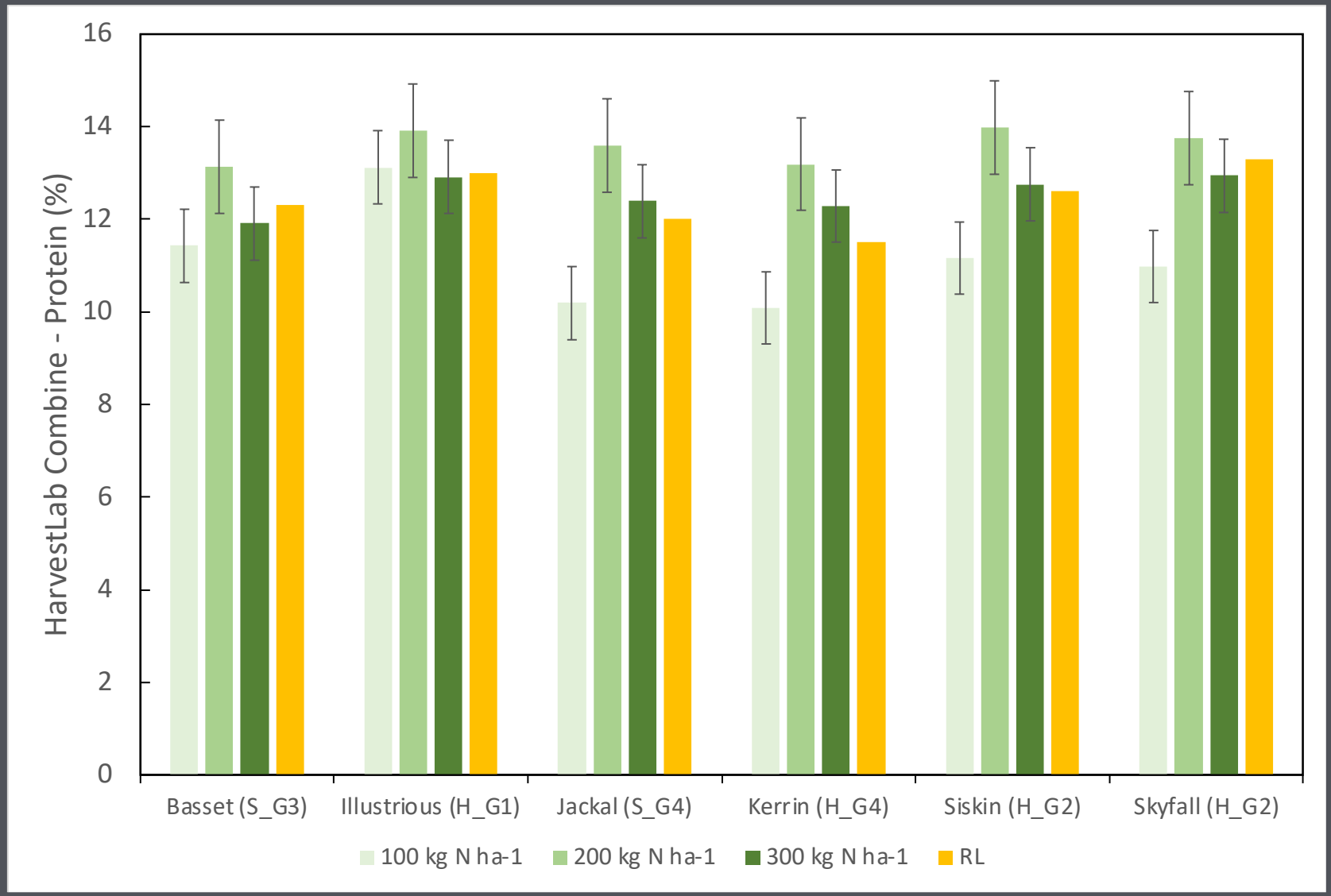
Constituent Sensing of Small Grains



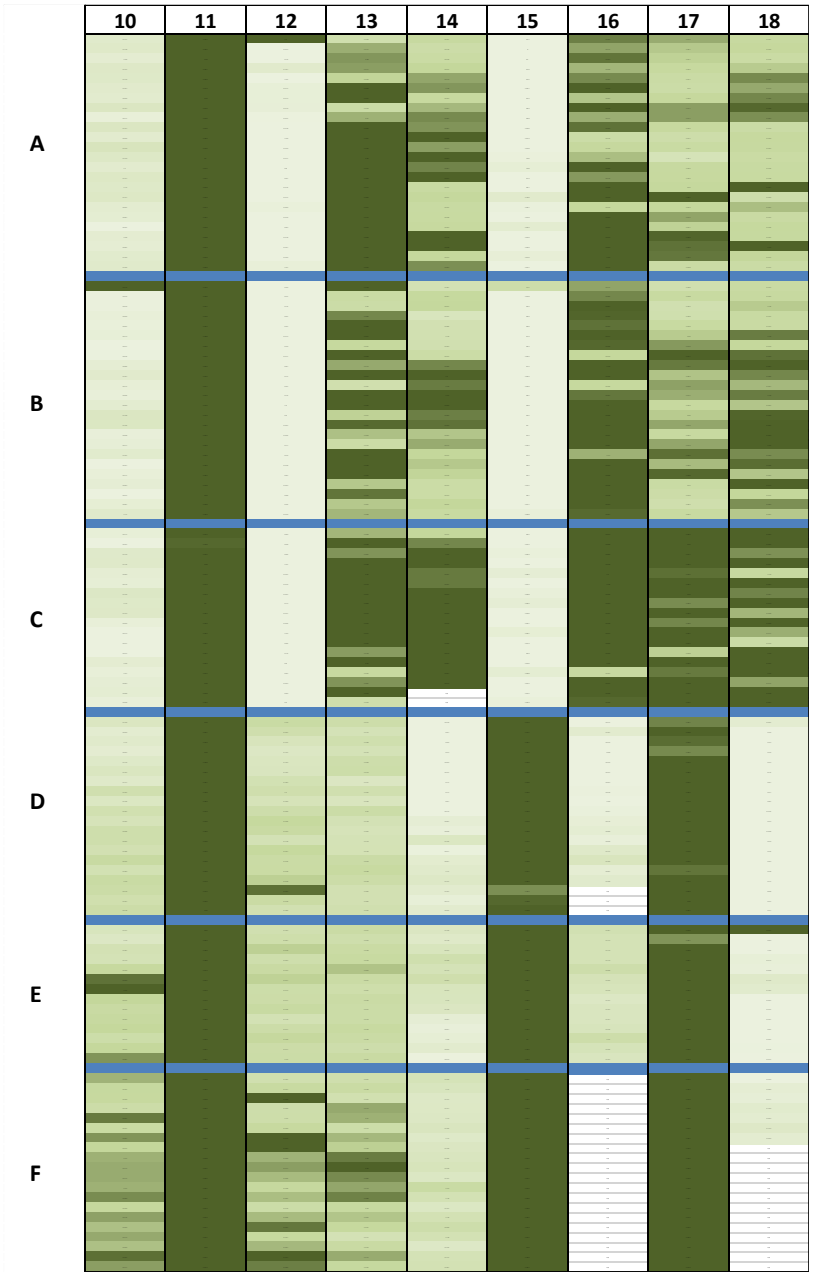
Adjustable, spring-loaded gate to control grain flow across the sensor window whilst maintaining a grain depth of 50 mm



Started with Wheat and Barley in 2019



Variety – N fertiliser rate interactions



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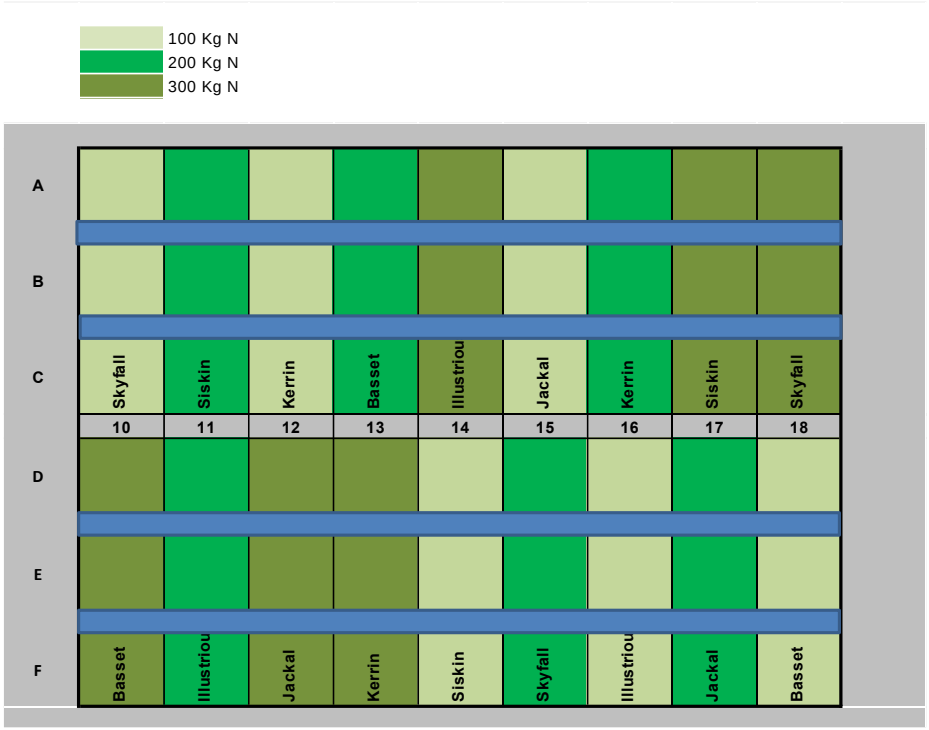

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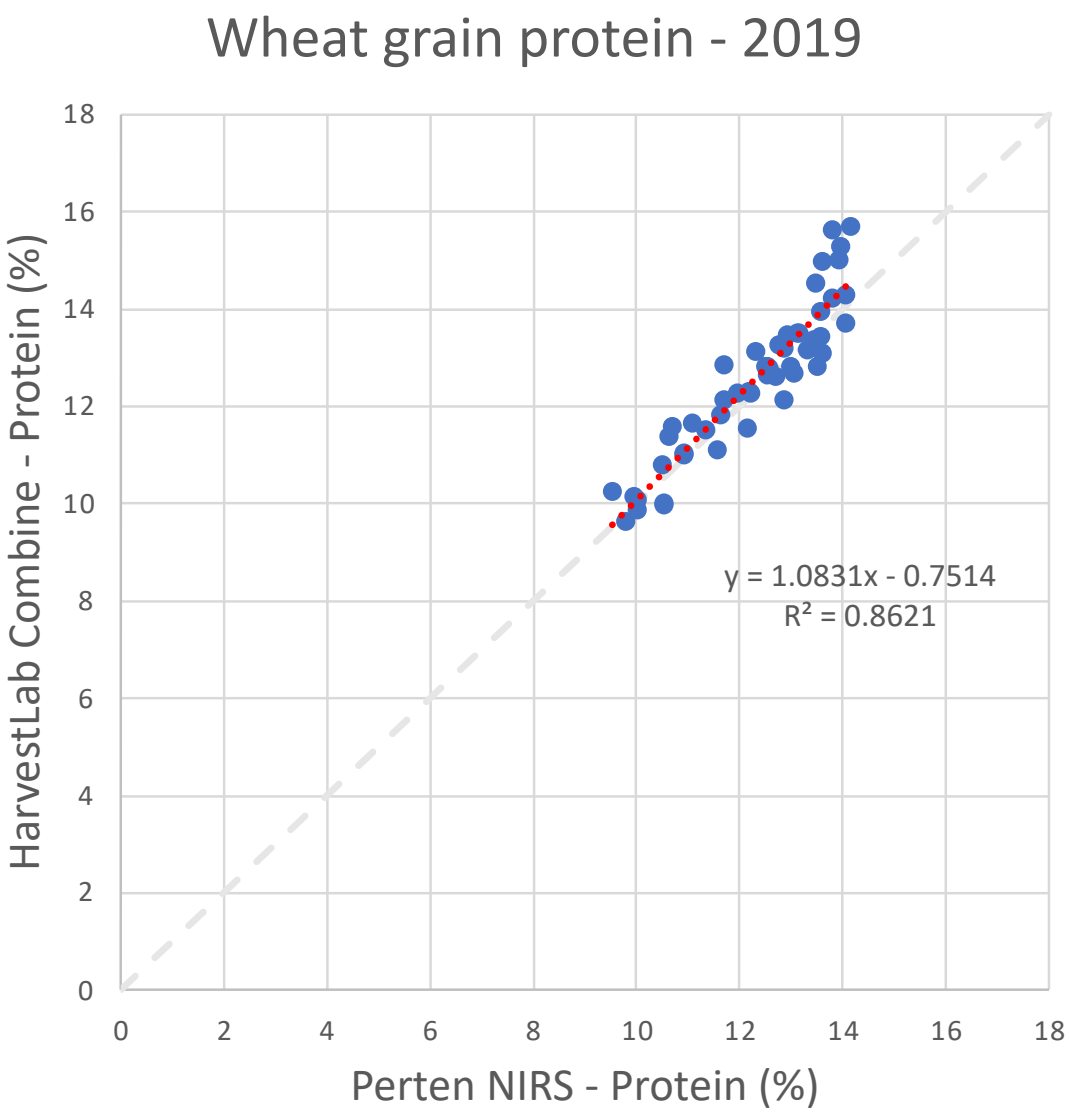

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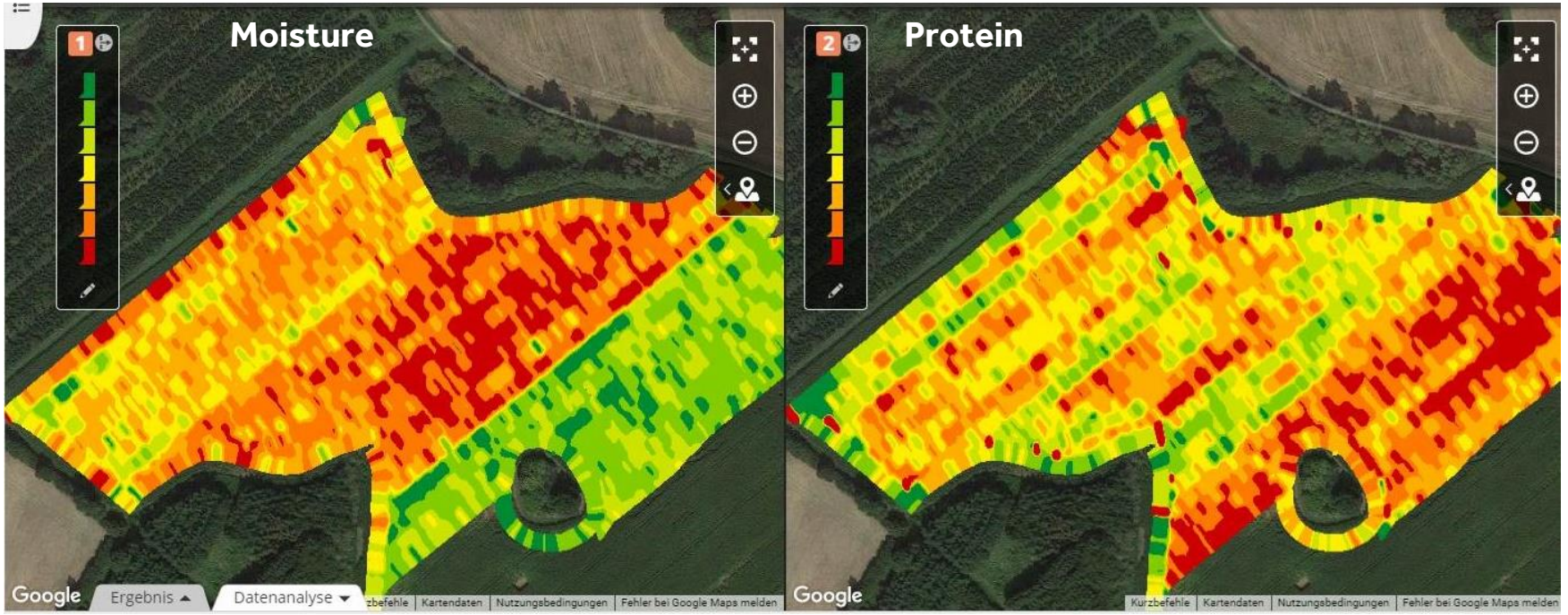
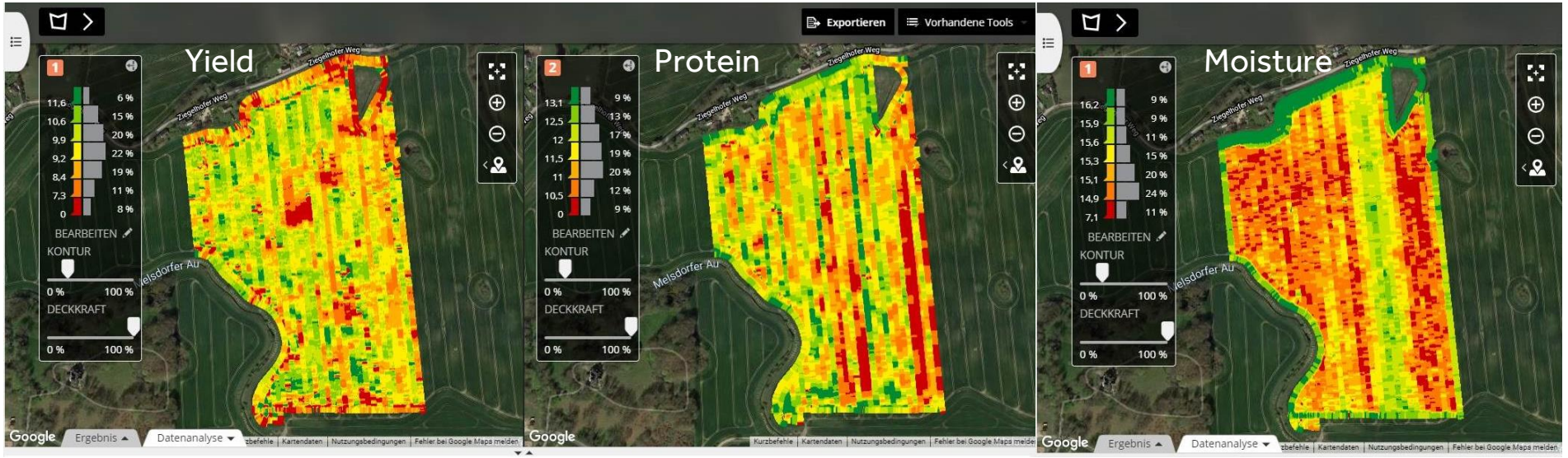
Wheat Moisture and Protein

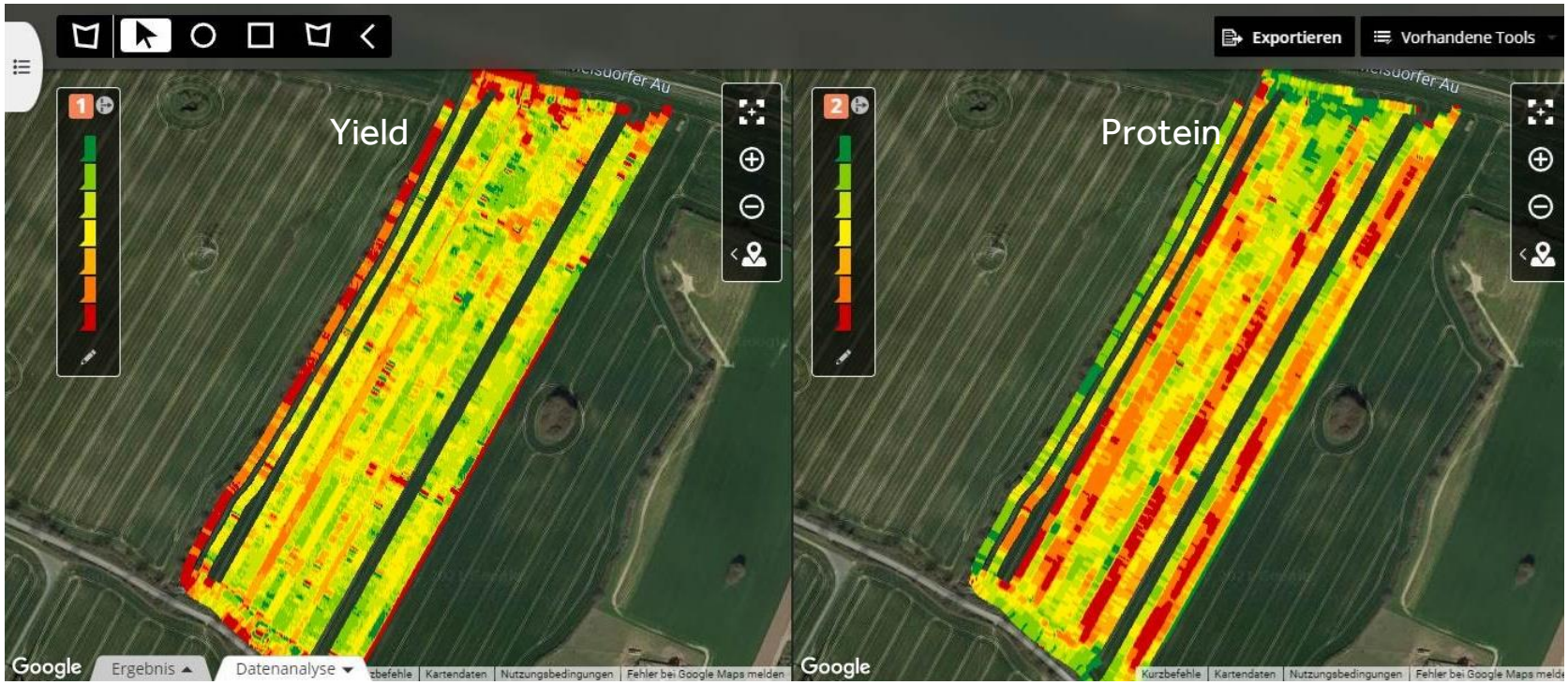


Wheat Yield and Protein



Experimental Field (Fertilizer Spreader created stripes)

Wheat Yield and Protein

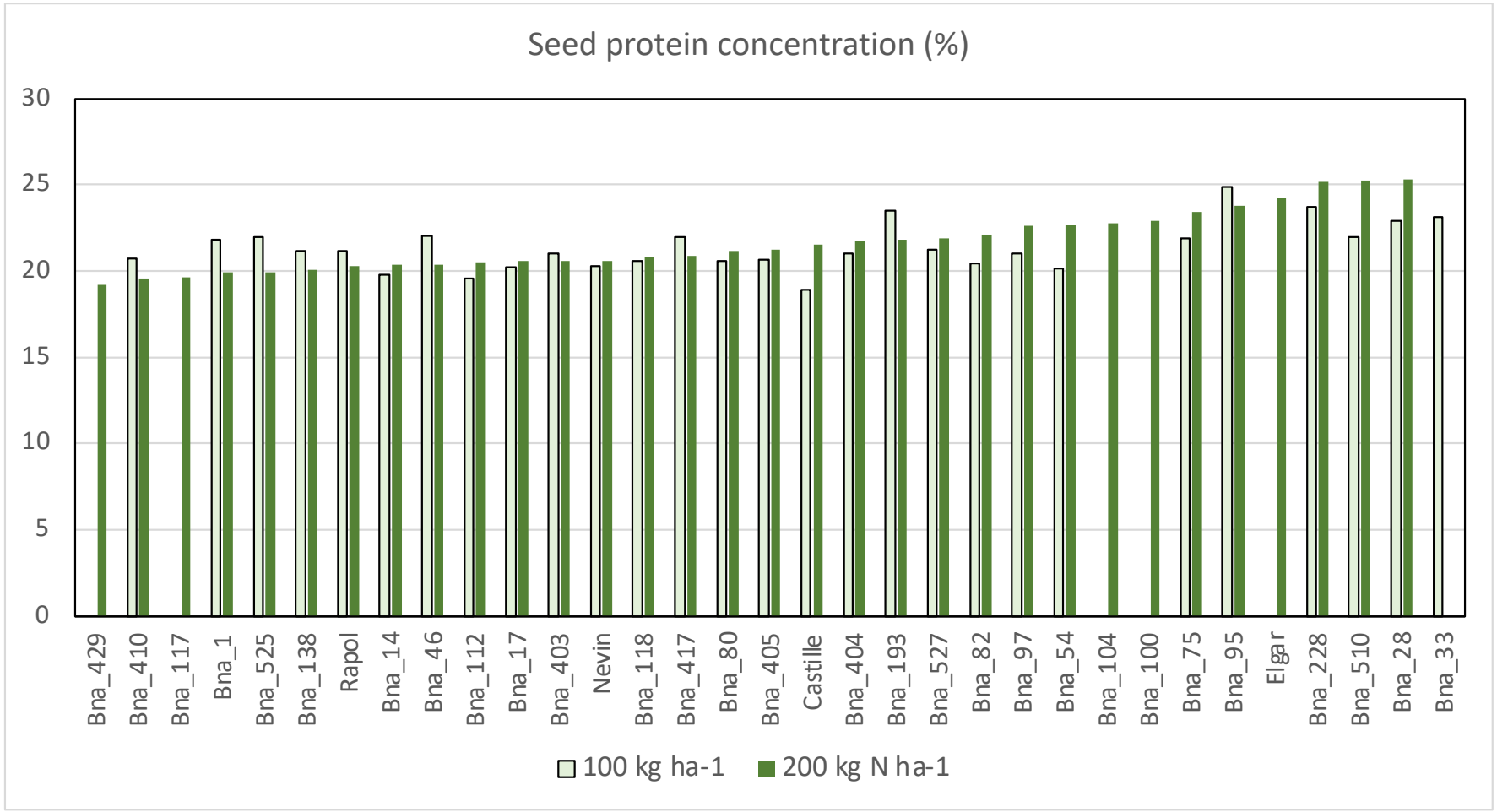


Oilseed rape experiments 2020

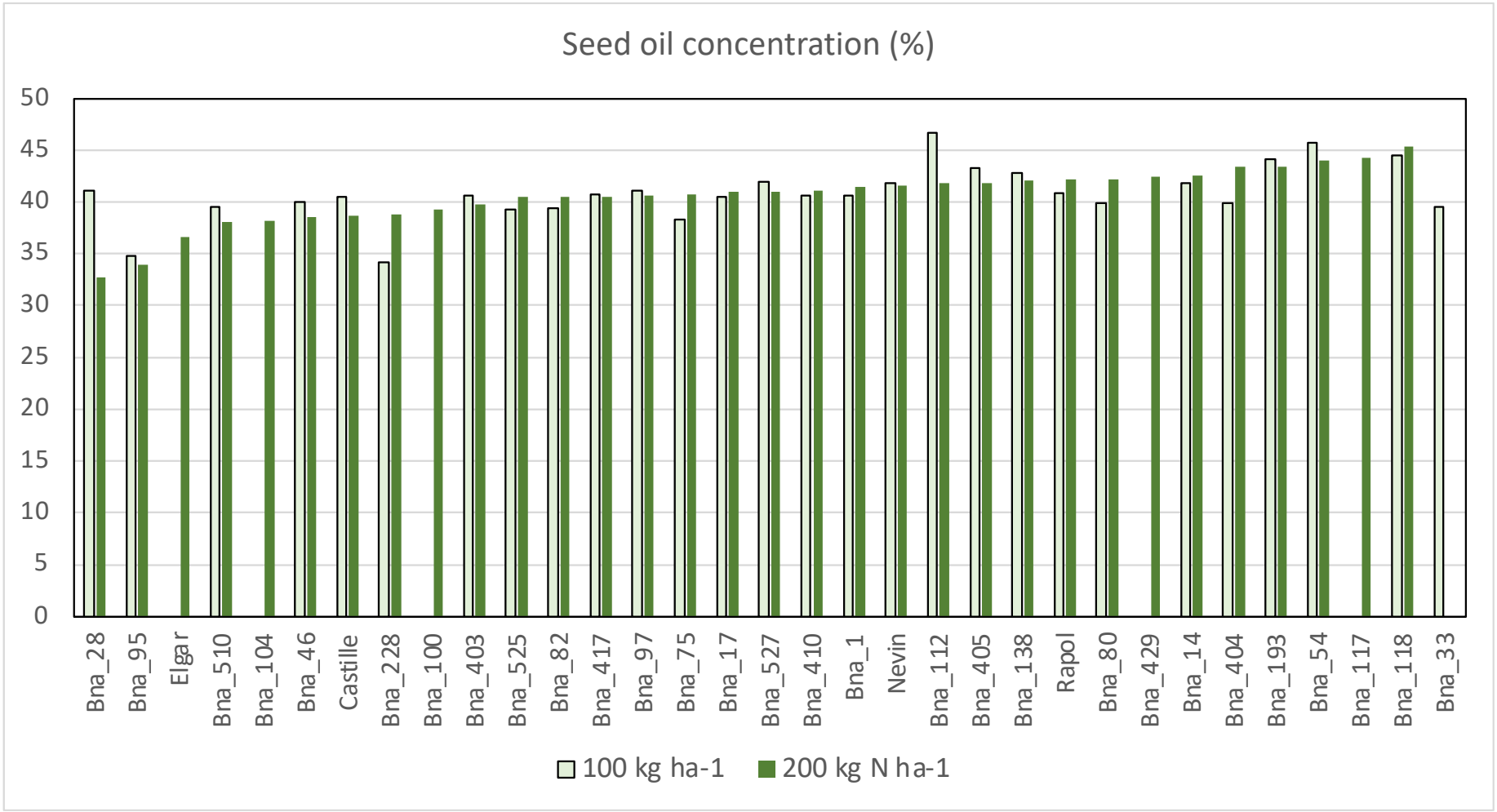
	Block 3									Block 2									Block 1									
	S	R	Q	P	O	N	M	L	K	J	I	H	G	F	E	D	C	B	A									
16	403	103	220	223	224	117	510	111	177	Elgar	100	417	412	223	446	Rapol	100	1	97	16								
15	403	103	220	223	224	117	510	111	177	Elgar	100	417	412	223	446	Rapol	100	1	97	15								
14	17	75	410	417	Elgar	Nevin	429	54	138	410	419	450	Castille	33	Nevin	430	413	104	527	14								
13	17	75	410	417	Elgar	Nevin	429	54	138	410	419	450	Castille	33	Nevin	430	413	104	527	13								
12	97	429	82	193	Castille	405	95	103	94	118	430	527	Castille	432	404	28	118	92	419	12								
11	97	429	82	193	Castille	405	95	103	94	118	430	527	Castille	432	404	28	118	92	419	11								
10	33	104	54	Rapol	28	404	421	432	Rapol	224	405	75	1	117	46	82	17	417	80	10								
9	33	104	54	Rapol	28	404	421	432	Rapol	224	405	75	1	117	46	82	17	417	80	9								
8	450	525	432	46	118	111	177	220	403	158	525	446	112	510	138	429	403	405	Elgar	8								
7	450	525	432	46	118	111	177	220	403	158	525	446	112	510	138	429	403	405	Elgar	7								
6	228	80	92	413	430	100	419	80	82	104	17	46	Nevin	75	450	94	111	112	228	6								
5	228	80	92	413	430	100	419	80	82	104	17	46	Nevin	75	450	94	111	112	228	5								
4	1	527	412	95	510	138	94	28	223	228	412	404	193	525	410	95	224	177	220	4								
3	1	527	412	95	510	138	94	28	223	228	412	404	193	525	410	95	224	177	220	3								
2	Spare	Spare	446	421	112	158	14	92	413	33	97	14	117	14	158	193	54	103	421	2								
1	Spare	Spare	446	421	112	158	14	92	413	33	97	14	117	14	158	193	54	103	421	1								
	S	R	Q	P	O	N	M	L	K	J	I	H	G	F	E	D	C	B	A									
	Block 3									Block 2									Block 1									

2020 started off very wet!

OSR 2020 – Seed protein variation in OREGIN material



OSR 2020 – Seed oil variation in OREGIN material



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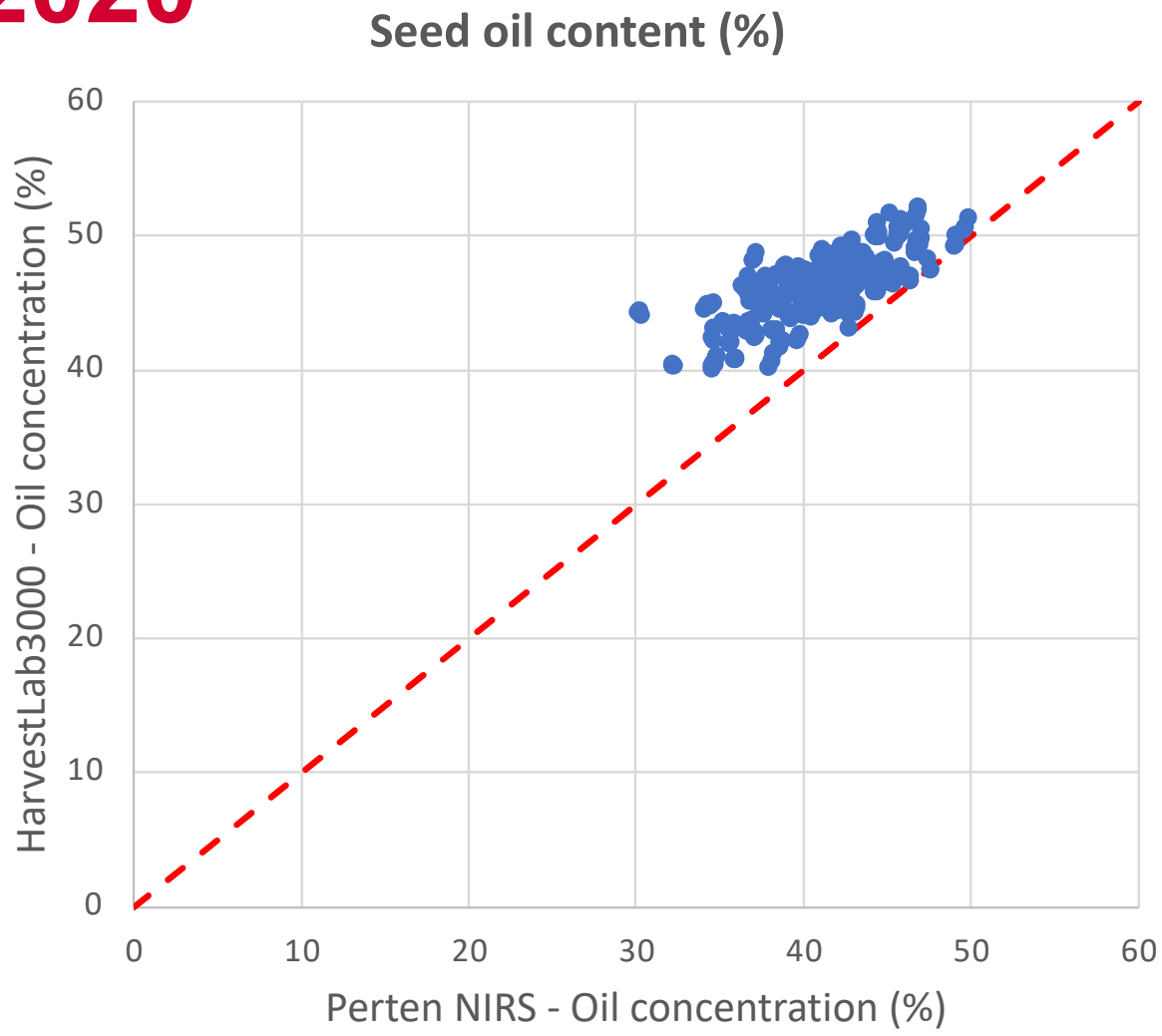
OSR 2020



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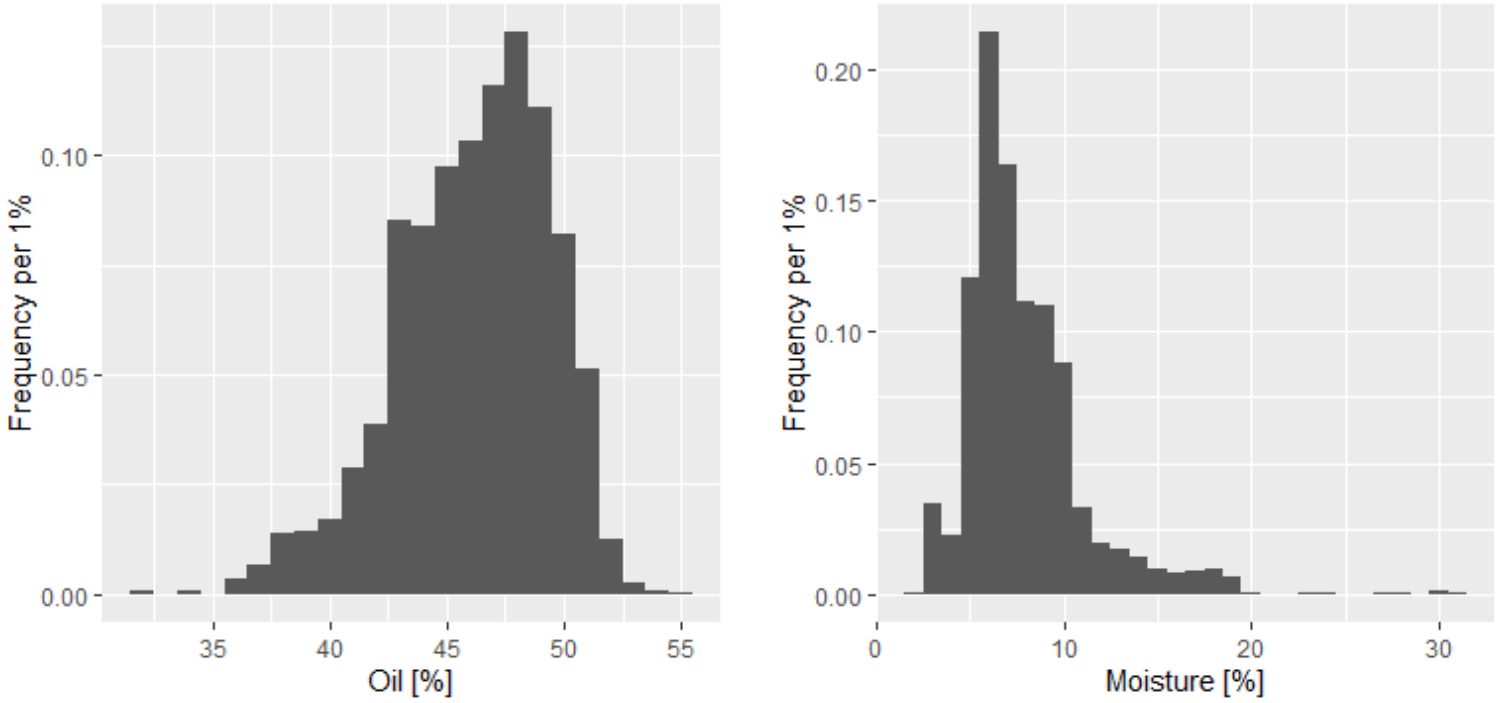
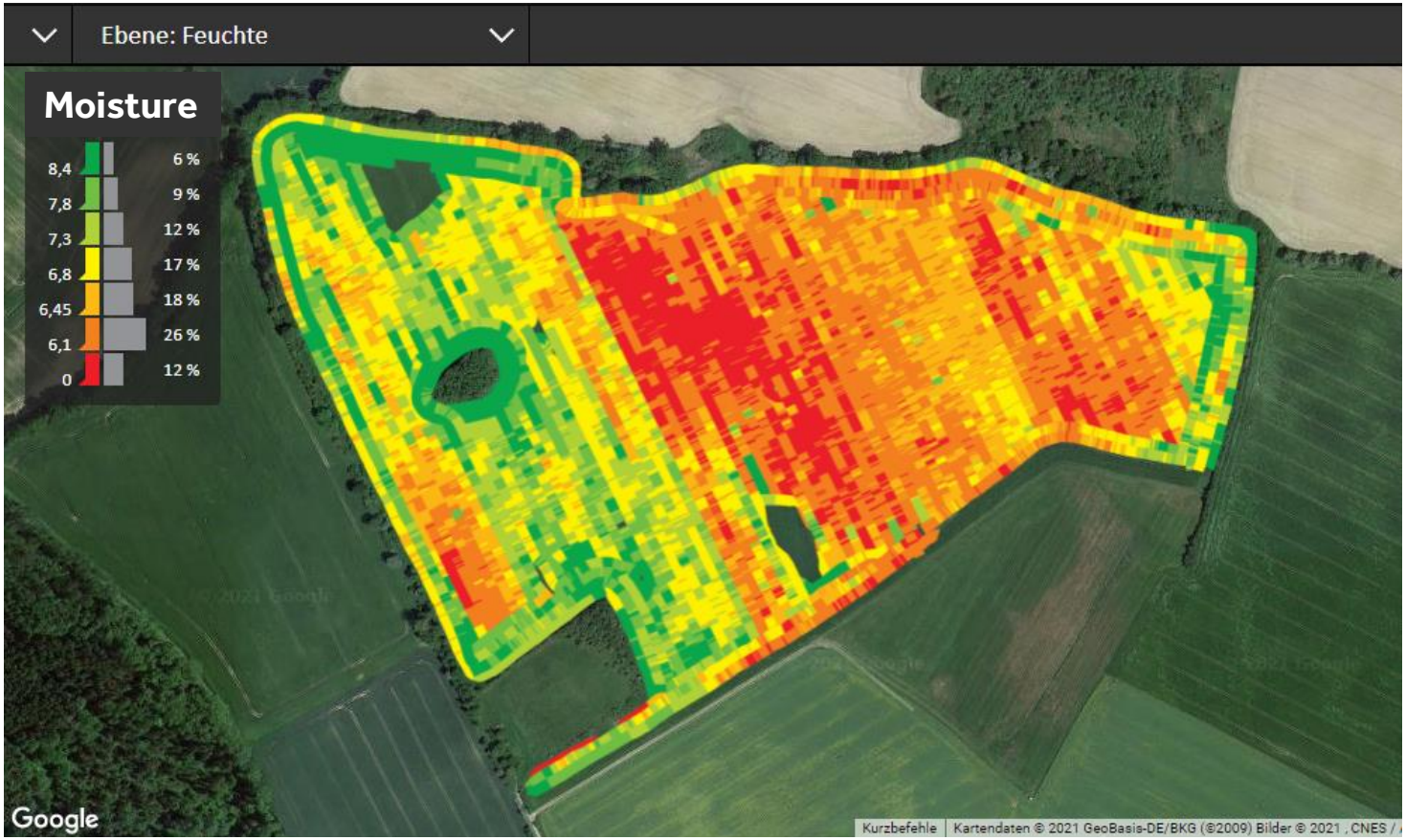
OSR Moisture and Oil Distributions



OSR Moisture



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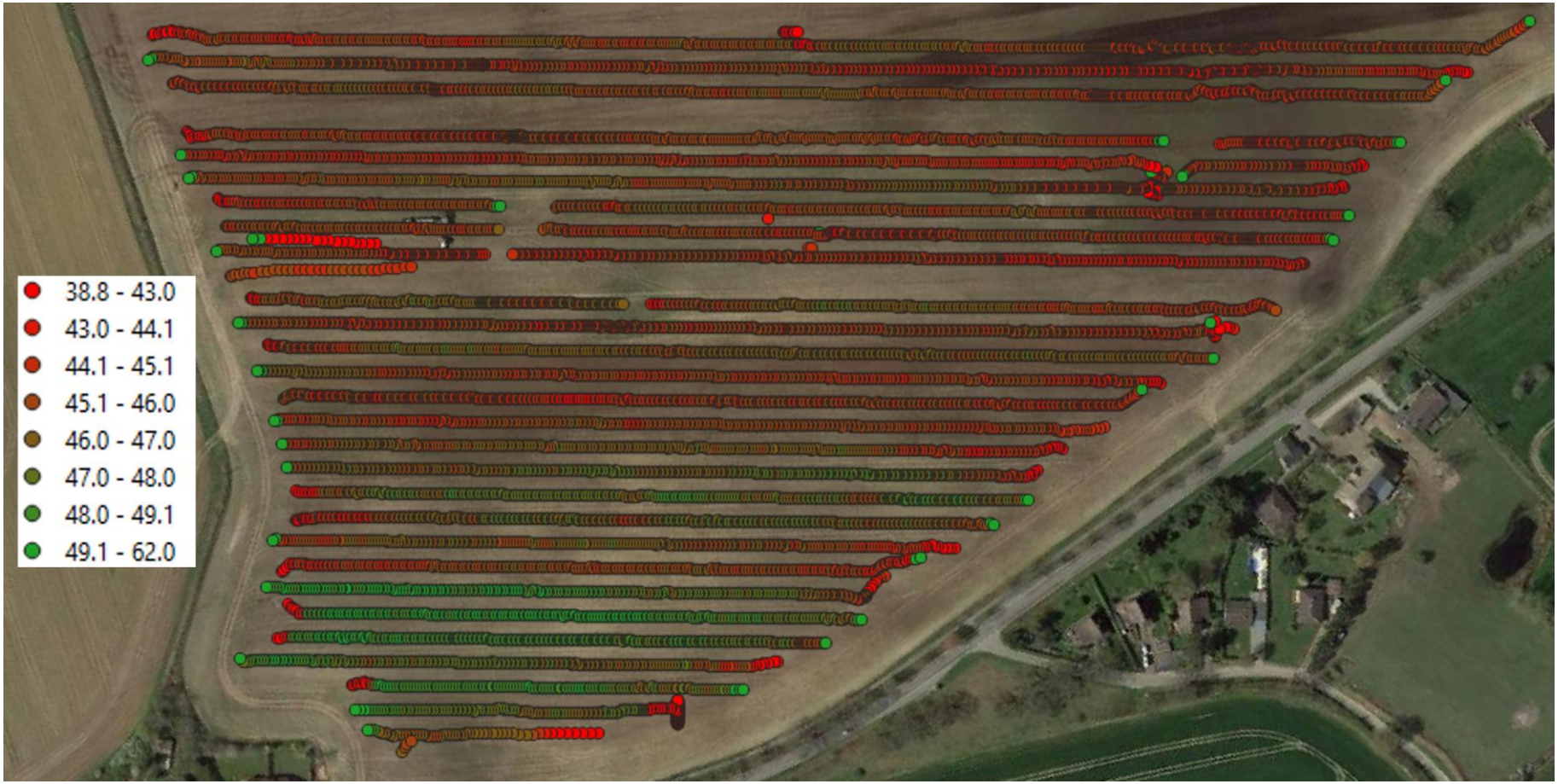
OSR Oil content



LINKDAPA

LINKing multi-source DAta for adoption of Precision Agriculture

Goal: Nudging farmers to adopt precision agriculture

Key focus: winter wheat in the UK, Germany and Italy

Partners:

- Reading University (UK)
- Hohenheim University (Germany)
- John Deere (Germany)
- Agricolus SRL (Italy)

Project: 2020-2022 (2022 still being finalized)

Key output: software platform commercialized by Agricolus

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Algorithm development using various data sources.

- Most sources are “big” data for each field.
- Spatial resolution varies with data type.
- We aim to use what is available plus
- The farmer’s local knowledge of the farm and fields.

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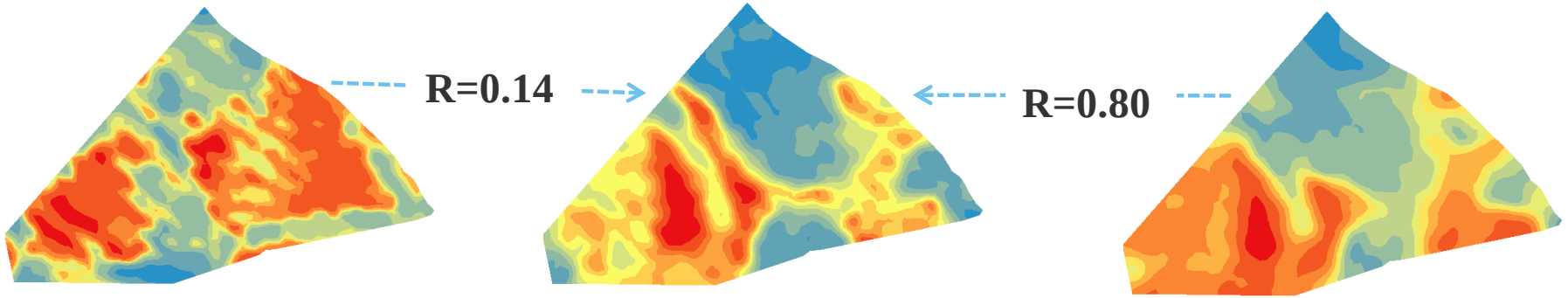
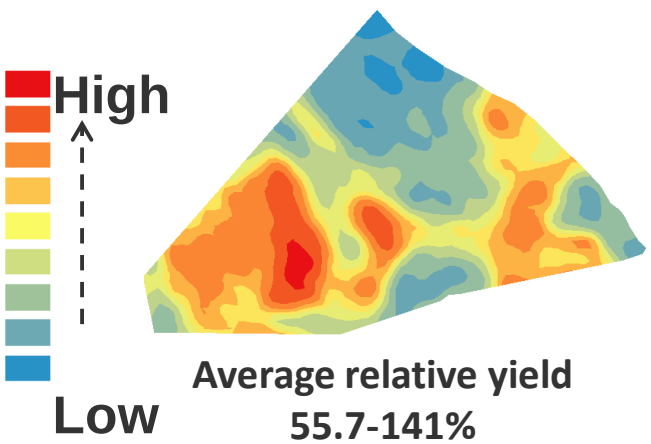
Yield, Soil types and Elevation maps from 2017 to 2020 – Chalkhouse field



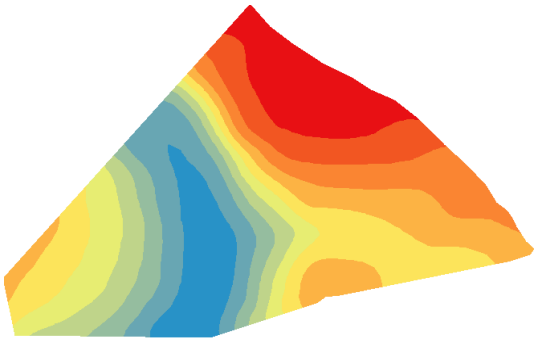
Oilseed rape in 2017
1.2-4.8 t/ha

Wheat in 2020
2.6-9.1 t/ha

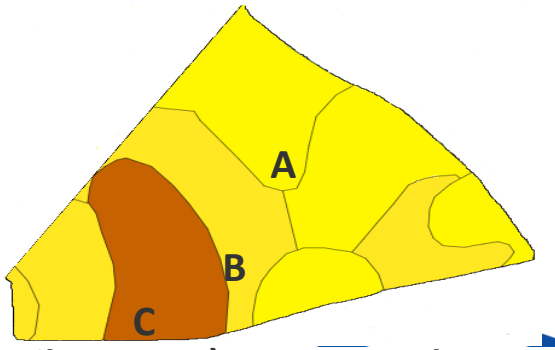
Wheat in 2018
4-9.5 t/ha



Average relative yield
55.7-141%



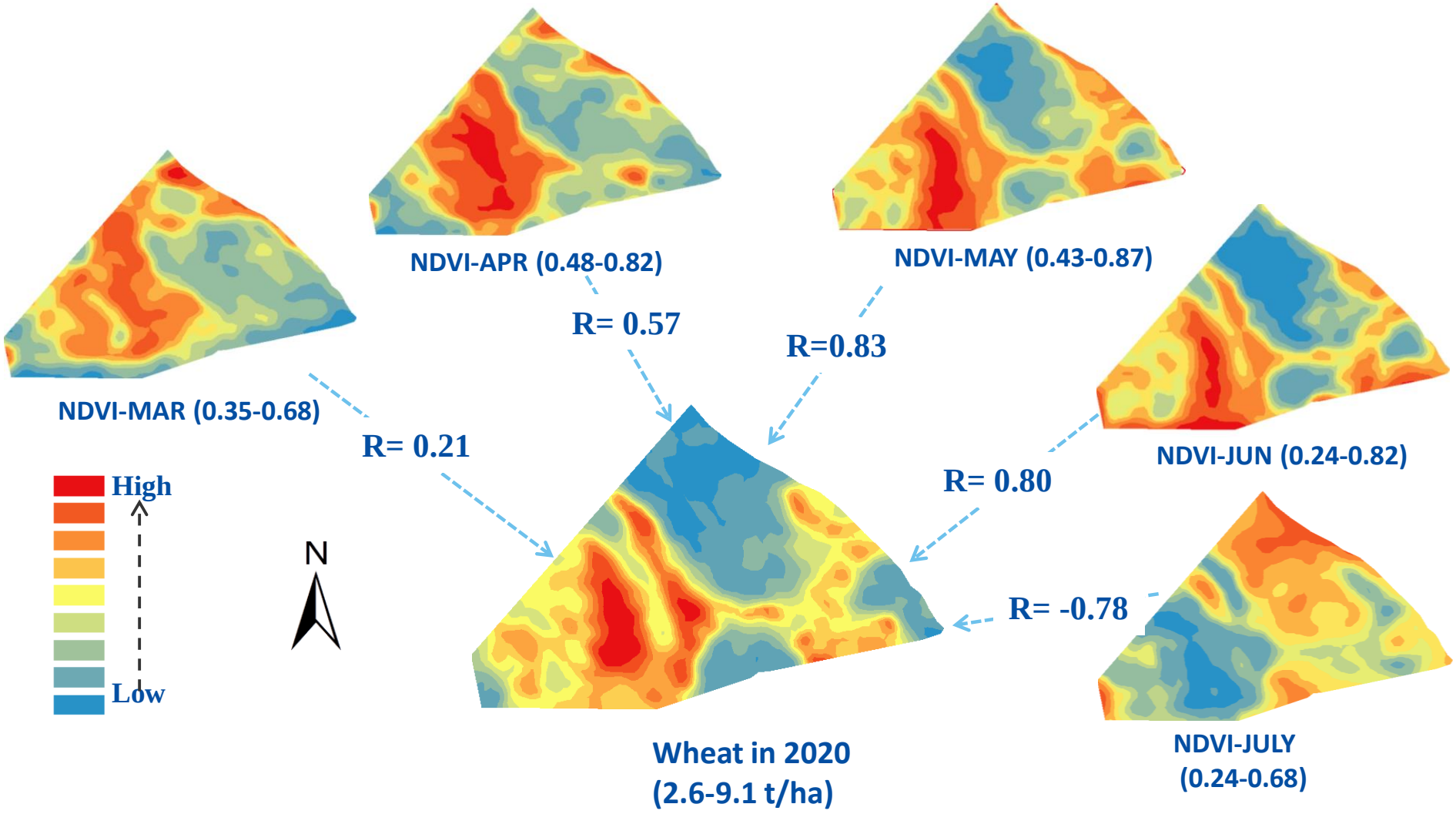
Elevation (62.6-70.8 m)



Soil types: A) Loamy sand
B) Sandy loam, C) Heavy sandy clay

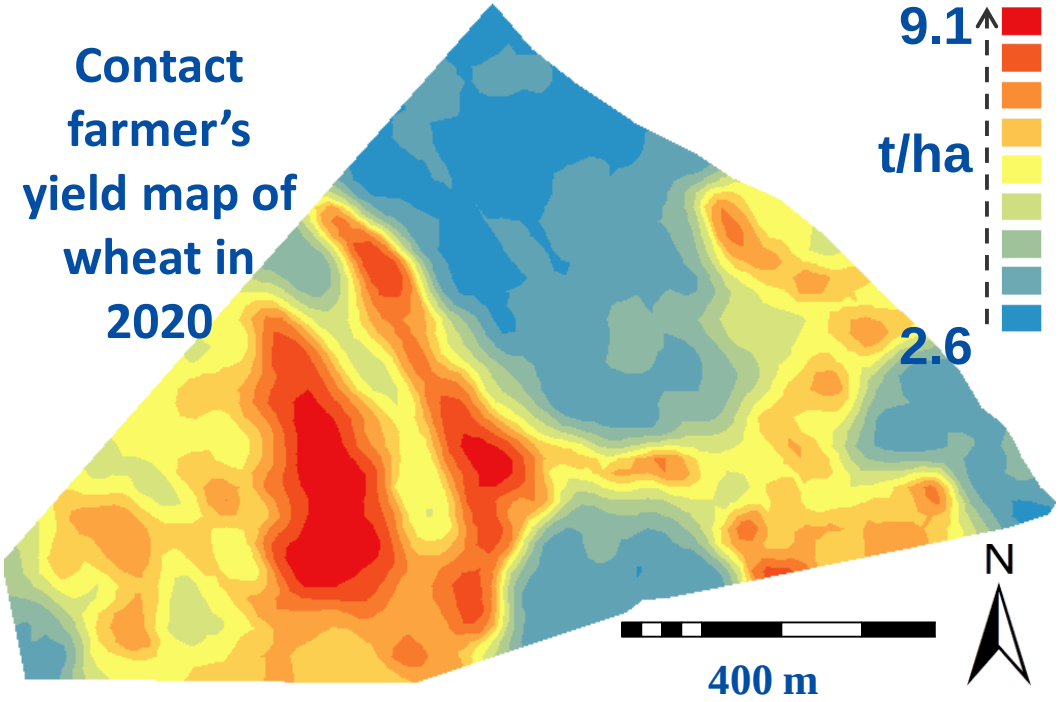
Optimum time for prediction

Correlation between wheat yield and NDVI in Chalkhouse field in 2020 - under **VRA-N**



Model outputs

Predicting spatial variability in wheat yield, grain protein and profitability



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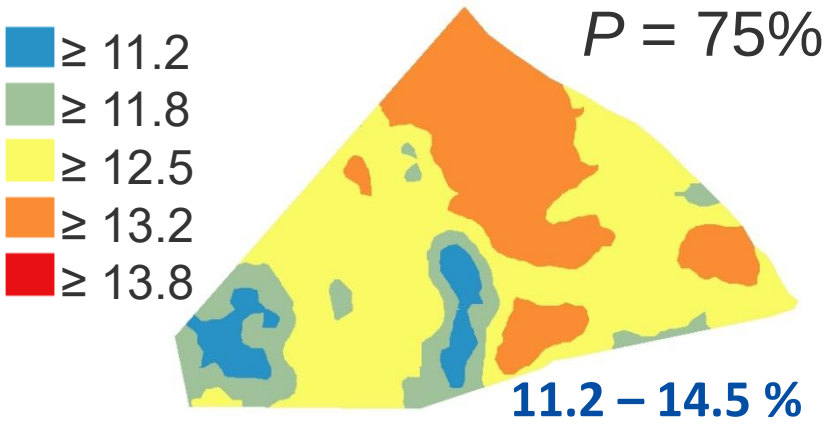
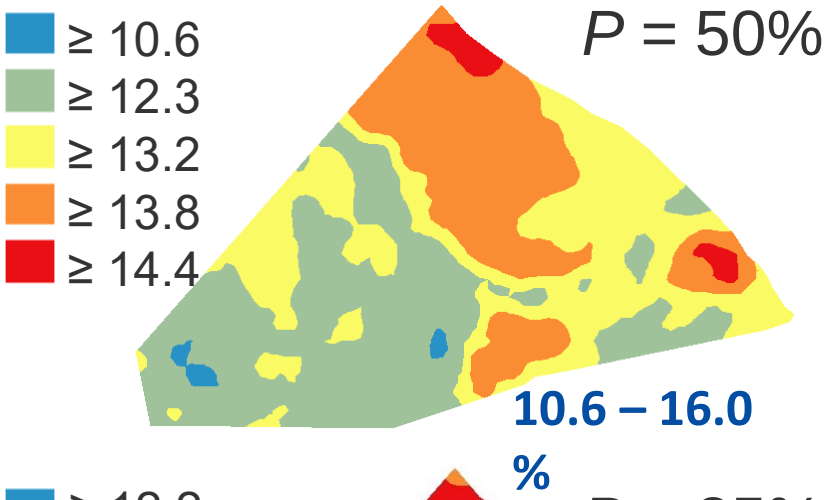
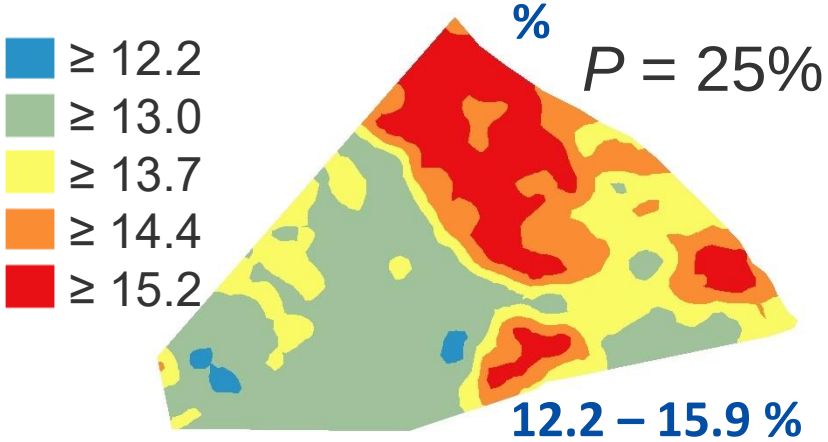
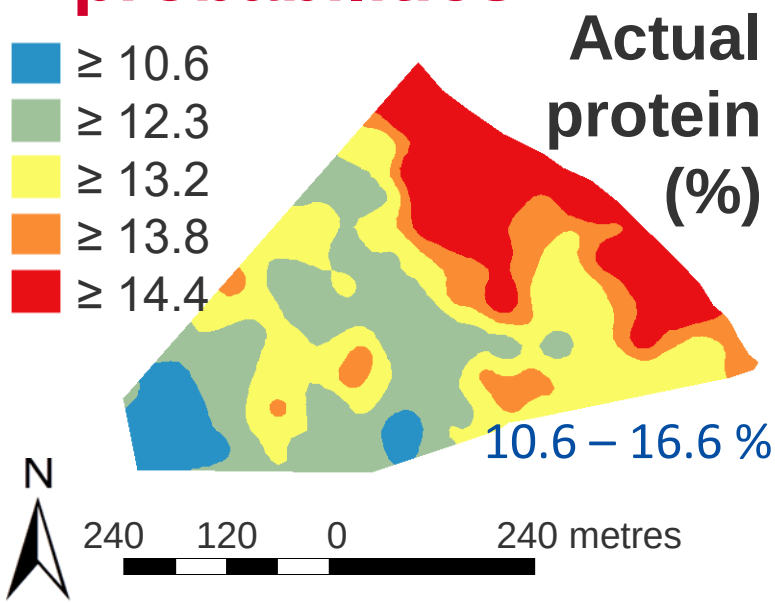
Predicting grain protein (%) at different probabilities









KEY

Red = " HIGH protein "

Blue = " LOW protein "

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LINKing multi-source Data for Adoption of Precision Agriculture

Software platform

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Acknowledgements

Richard Casebow
Caroline Hadley
Mariana Kruger
David Casebow
Lindsay Todman (LINKDAPA)
Alistair Murdoch (LINKDAPA)
Salar Mahmood (LINKDAPA)
Richard Tranter (LINKDAPA)

University of Reading

JOHN DEERE

Thomas Engle
Peter Schade
Panambilly Ambarish

Funding

Department for Environment Food & Rural Affairs

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Thank you.