Yield and protein data from recent years can improve N-fertilization practices

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Thursday January 11th

STØTTET AF

Promilleafgiftsfonden for landbrug

SEGES INNOVATION

Agenda

- Motivation and background for study
- Method
- Results
  - Field experiments (mainly N, with a small remark about P)
  - Data recorded in MarkOnline
- Recommendations and future perspectives

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Motivation for study

In the years with supoptimal N-norm a lower protein percent was observed

Excising grain samples:

- When farmers sell a batch of grain
- However, if not for bread or malt barley, protein commonly not measured

Aim:

- Explore the relationship between protein percentage, yield, and nitrogen application and identify threshold values
- Improve future nitrogen fertilization practices

Can yield and protein data from recent years improve N-fertilization practices?

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Background

- Nitrogen application rates highly affects protein content
  - Higher N rates = higher protein content

- From 1999 to 2015 nitrogen fertilization norms were below optimum
  - Decreasing protein content in harvested grain

- There has been conducted over 1,000 field experiments in winter wheat with increasing nitrogen application: time to step back and have a look

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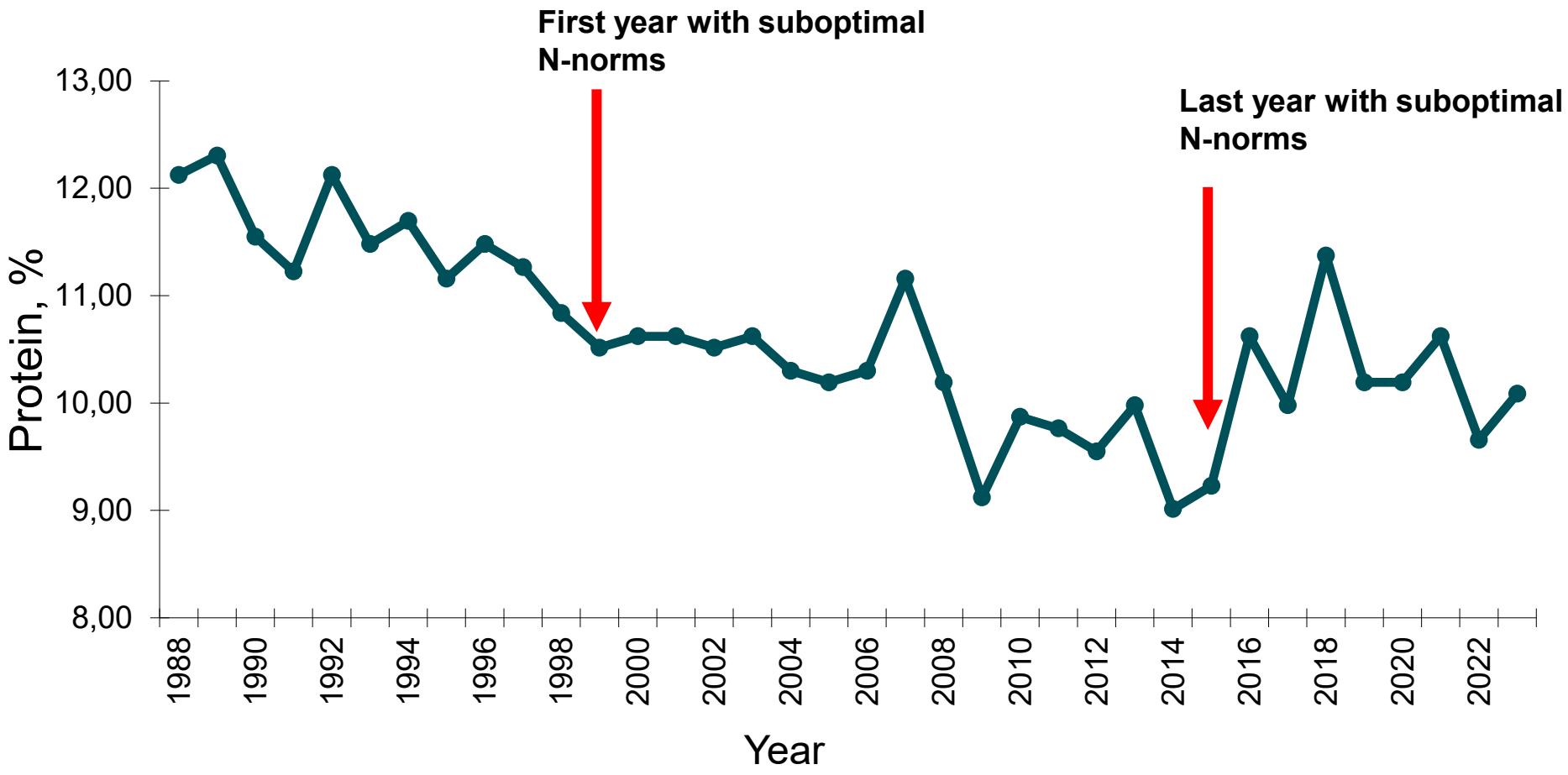
Development in protein content in harvested winter wheat



S. S. Grove and N. M. Sloth, 2023, Landbrugsinfo.dk

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Method

Comprehensive dataset:

- Time period: 1987-2020
- 1,090 N rate experiments in winter wheat
- Yield and protein percentage

Data cleaning:

- Experiments with missing data/ errors removed
- Only treatment with N-rates between 50 and 250 kg N/ha used
- A total of 3757 observations in a total of 752 experiments

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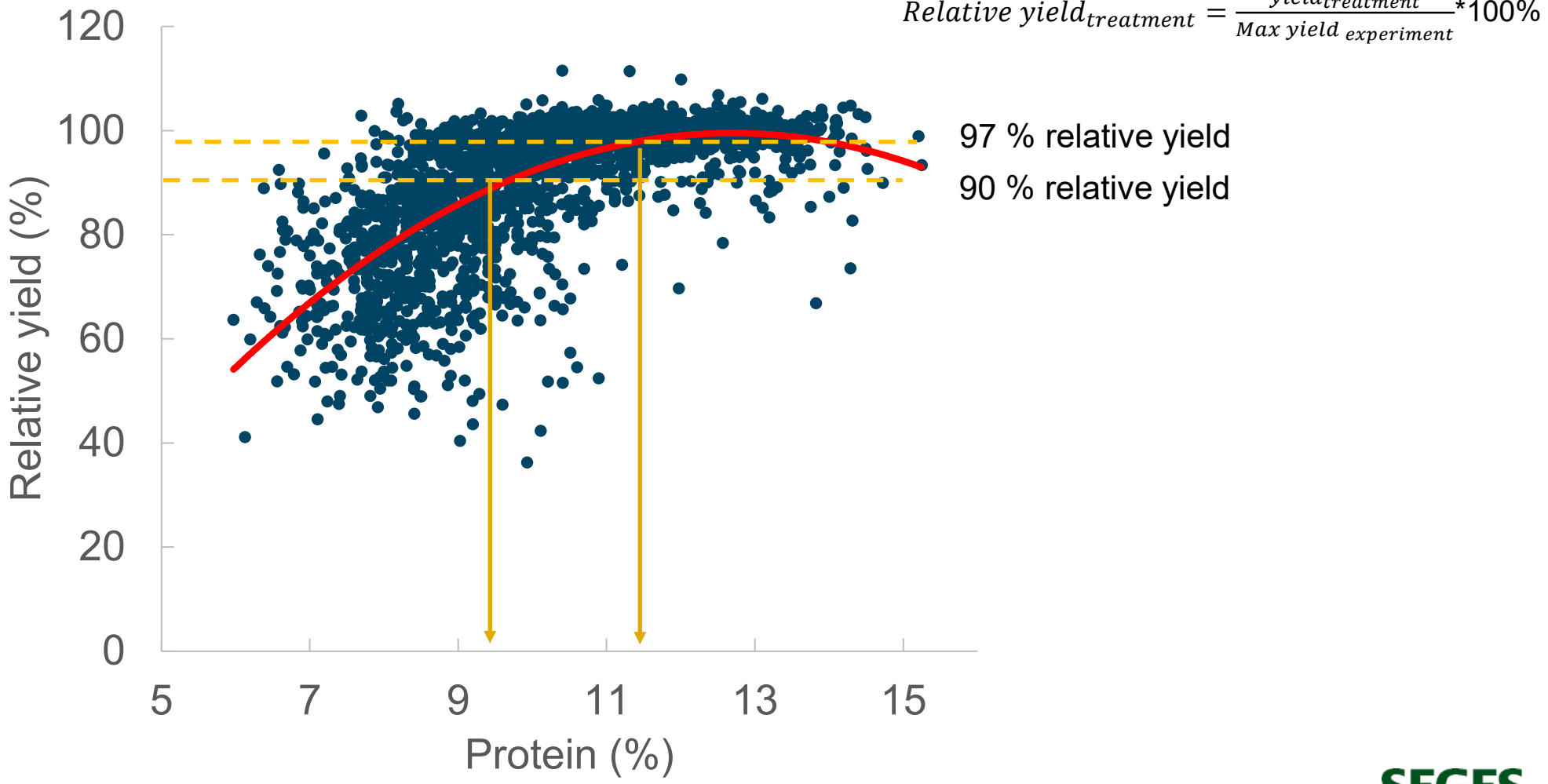
Correlation between relative yield and protein

$$Relative\ yield_{treatment} = \frac{yield_{treatment}}{Max\ yield\ _{experiment}} * 100\%$$



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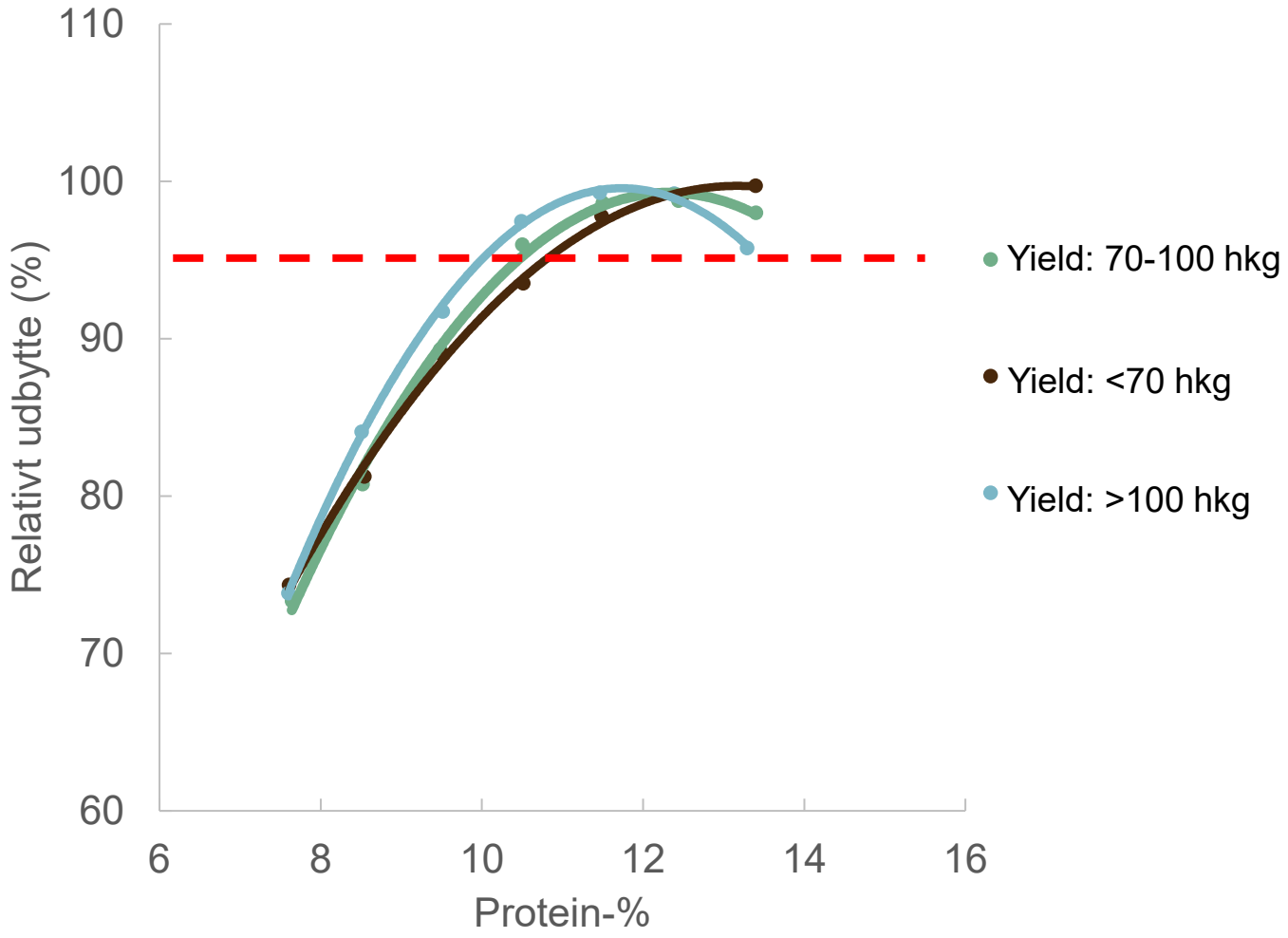
Small differences in optimum for different yield intervals

Optimum:

<70 hkg/ha:	10,8 %
70-100 hkg/ha:	10,4 %
>100 hkg/ha:	10,0 %



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Recommendations for winter wheat

Protein %	
Below 9.5 %	High likelihood that the crop has been undersupplied with nitrogen Risk of yield loss
9.5 % to 11.5 %	The nitrogen application has likely been sufficient
Above 11.5 %	Highly likely that the crop has received an excess of nitrogen

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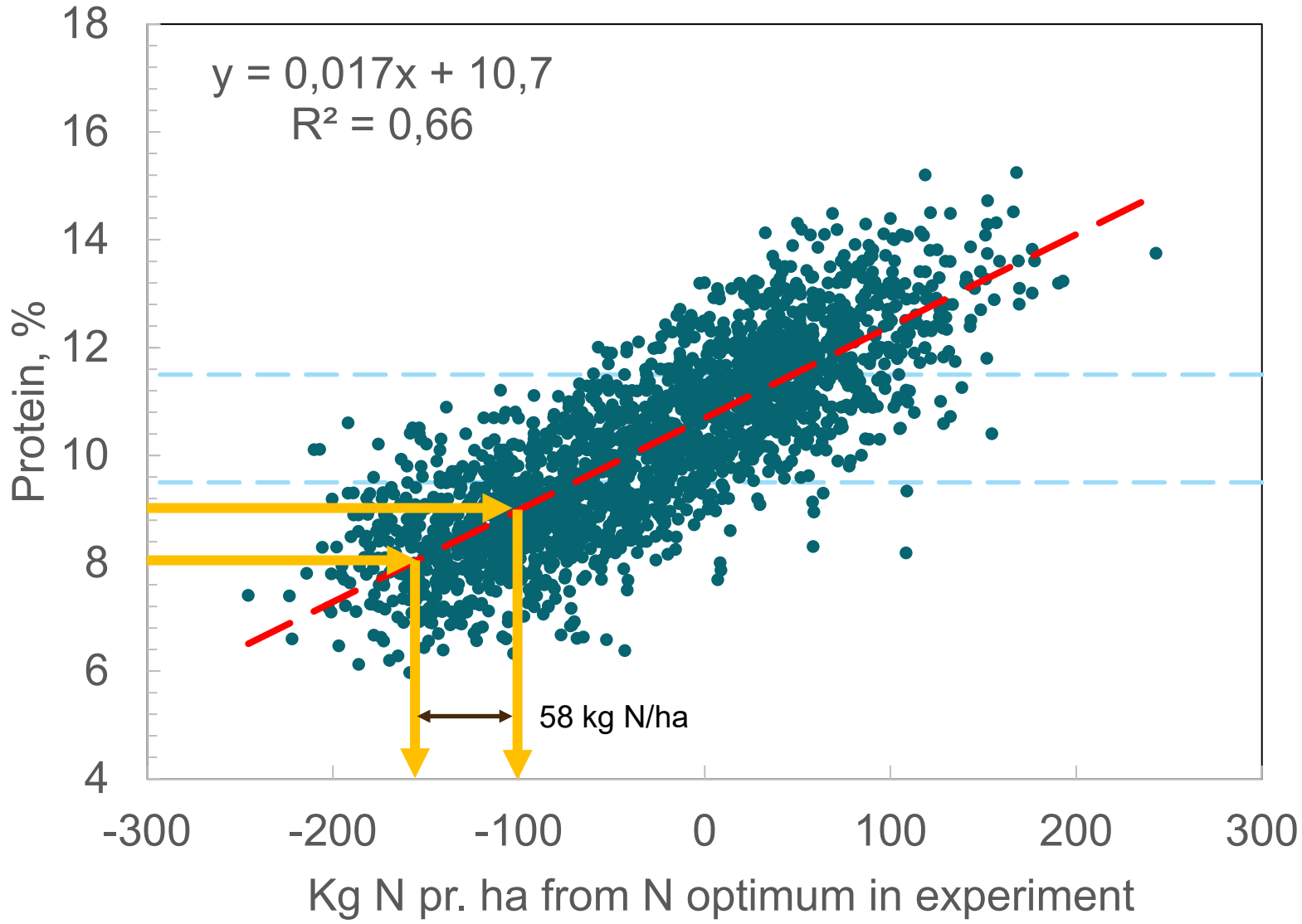
Using protein percent: How far away from optimum N?

- In each N-rate experiment optimum is calculated
- In each N-treatment the distance measured in kg N/ha is calculated
- For every 10 kg N/ha extra the protein percent will increase 0,17 %



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Yield and protein registered at field level

Data:

- Yield and protein content registered at field level for winter wheat
- Data registered in MarkOnline
- From 2018-2021
- A total of 282 field with registered yield data
  - Only 121 fields left after cleaning of data
- Nitrogen source: both mineral fertilizers and animal manure

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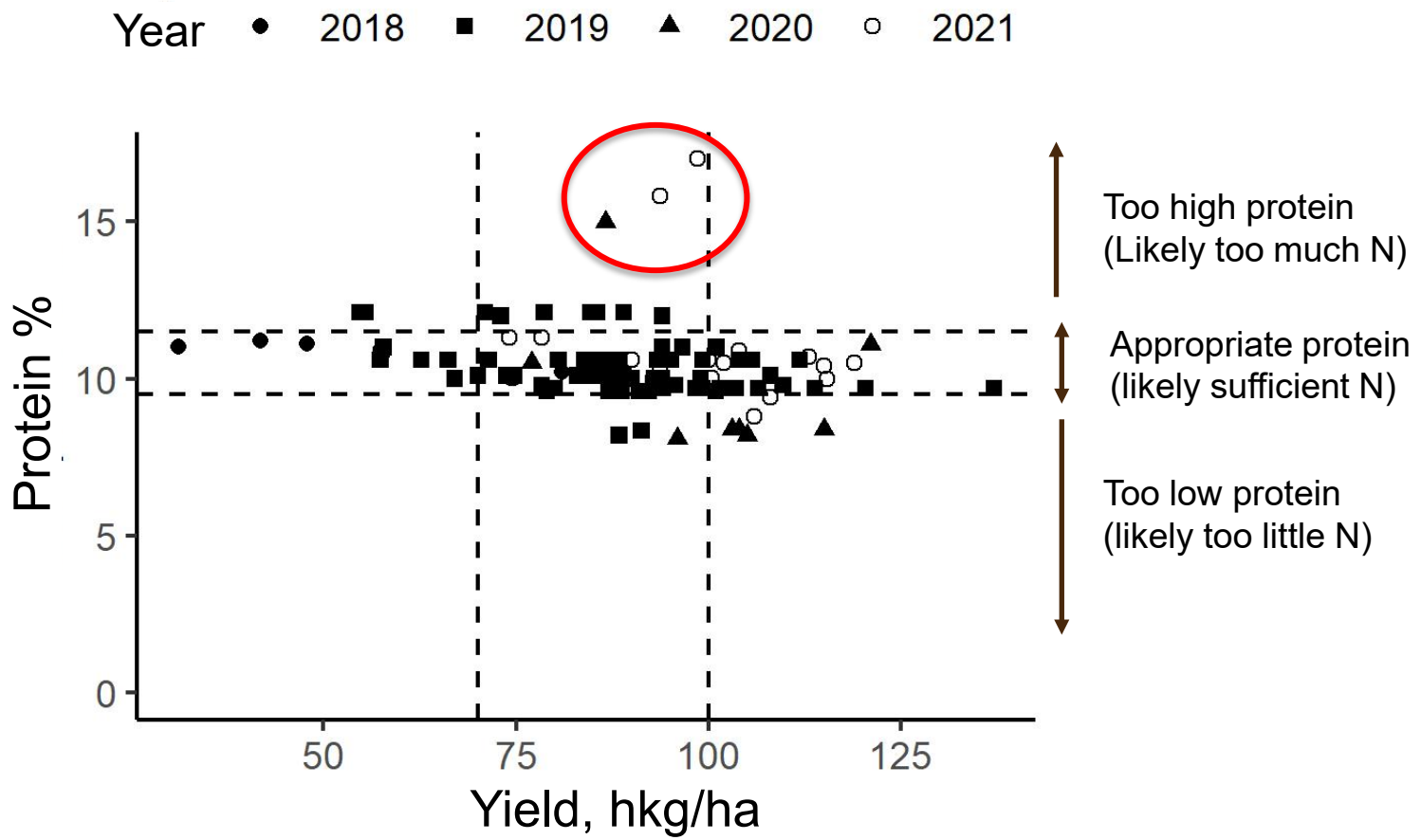
Registered yield and protein content



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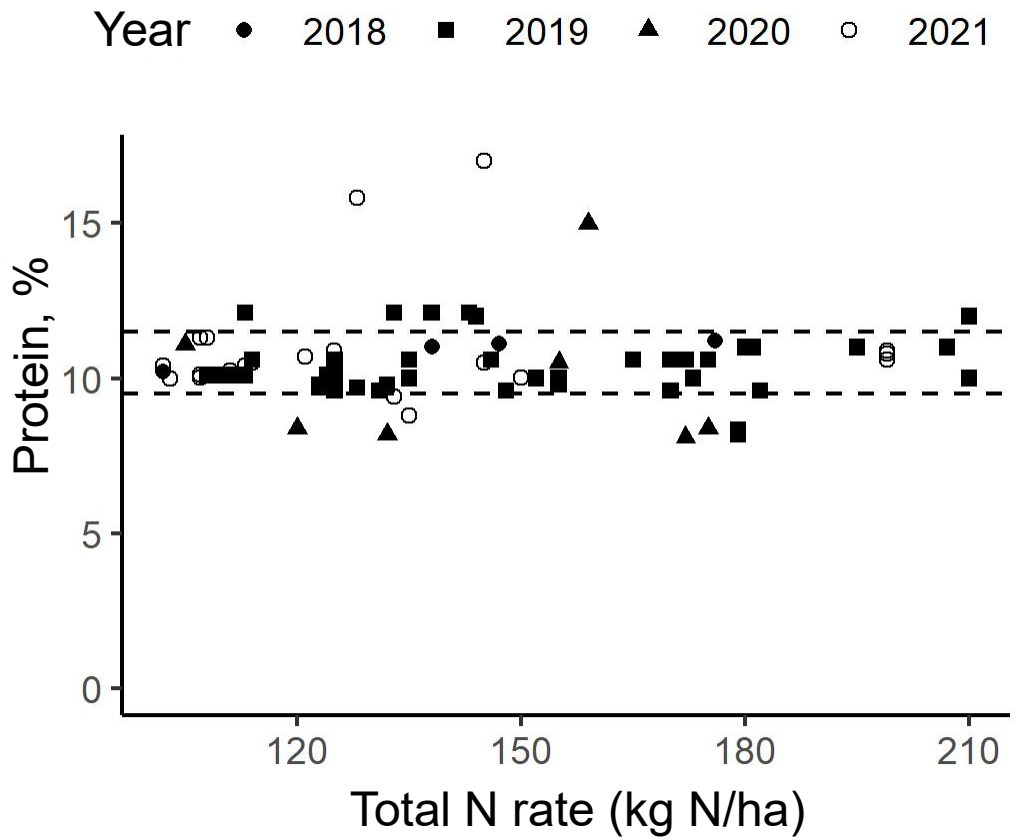
Nitrogen rate and protein percent

- No increase in protein percent with increasing N rates
- Is the quality of the registration of N rate at field level good enough?



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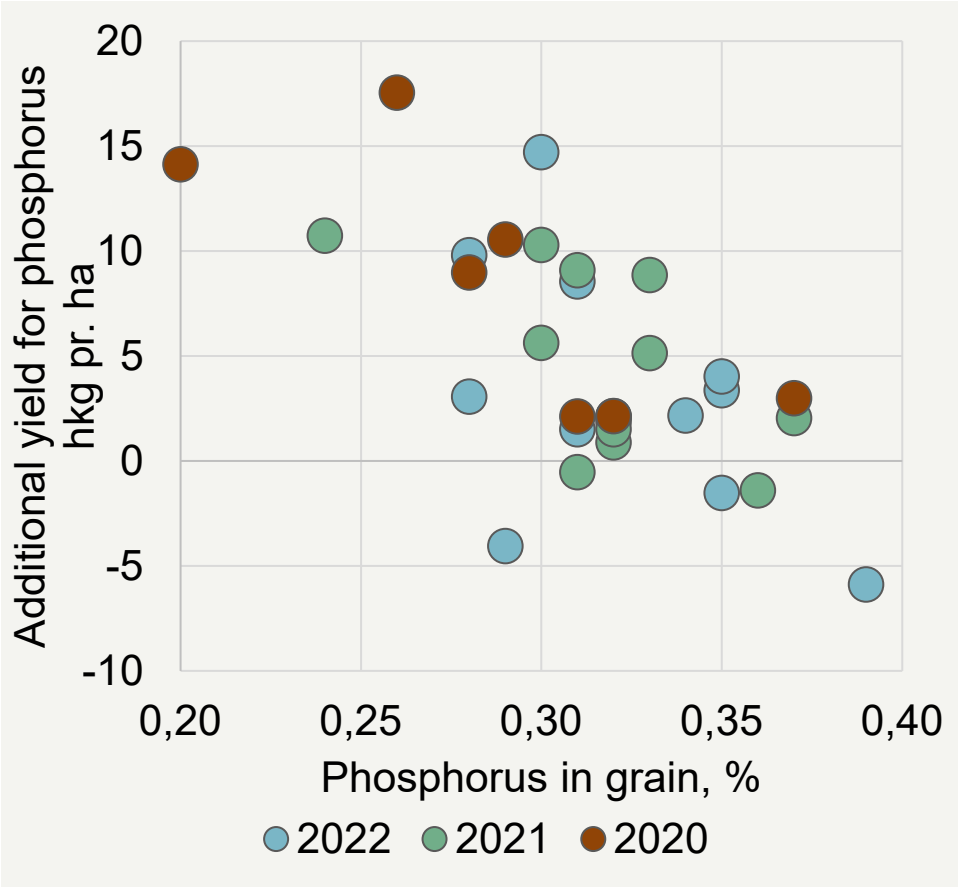
Phosphorus in grain analysis

- 32 field trials in spring barley with and without phosphorus fertilization
- Years: 2020-2022
- Phosphorus content in grain analysis can reveal if the plants have lacked phosphorus during the growing season



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Conclusion

Initial question:

Can yield and protein data from recent years improve N-fertilization practices?

Answer:

Yes

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Conclusions

- Clear potential to make better use of excising grain samples
- Information about protein percent represents valuable knowledge to improve nitrogen fertilization planning
  - <9,5%: apply more N
  - 9,5-11,5 %: sufficient supply
  - >11,5 %: decrease N supply
- Phosphorus content in grain can reveal lack of phosphorus supply
- Can be integrated in future tools:
  - Especially if grain analysis becomes more common
  - There is still a lack in registration of yield and protein levels

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Future perspectives for using grain analyses

- Integrated part of fertilization planning
  - In future include other nutrients
- Farmer evaluation of fertilization strategy
  - Look at more years
  - Remember: other factors can affect protein and yield levels e.g. drought periods
- Visualization of fields
  - Red: Too high nitrogen application
  - Green: Optimal nitrogen application
  - Yellow: Too low nitrogen application

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ANAKORN – new projekt

- Inspired by the work done in U.K. on grain analysis and in the Field trials in DK
- Use new technology (LIBS) to make grain analysis cheaper
- Facilitate logistics and build a decision support system for grain analysis
- Goal: to improve the following years fertilization plans

NUTRI-CHECK NET

OPTIMISING CROP NUTRITION

ADAS

Harvest Analysis *to transform* Nutrition Management

Tamara Fitters, ADAS, UK

www.adas.uk

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UK Research and Innovation

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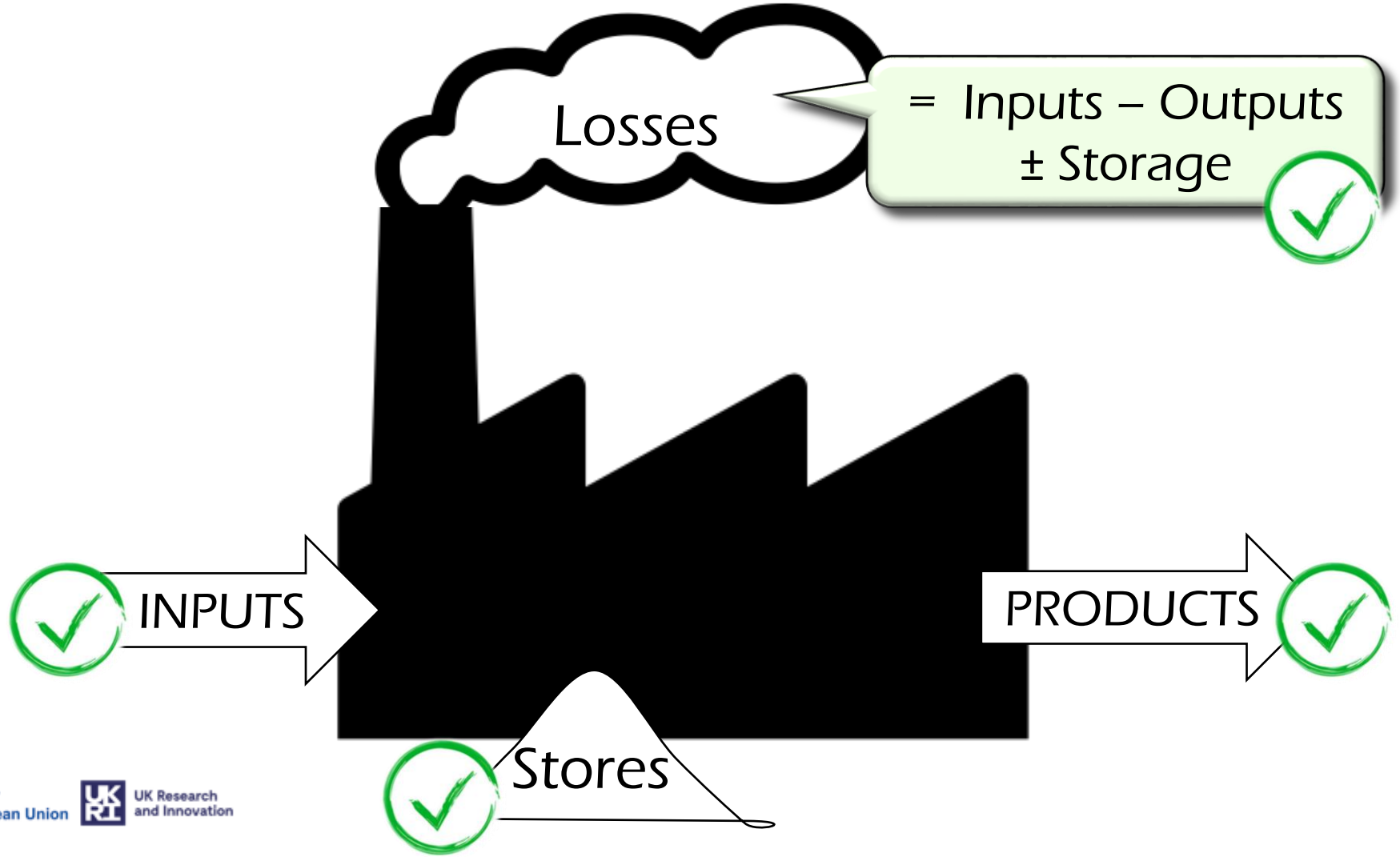
Management



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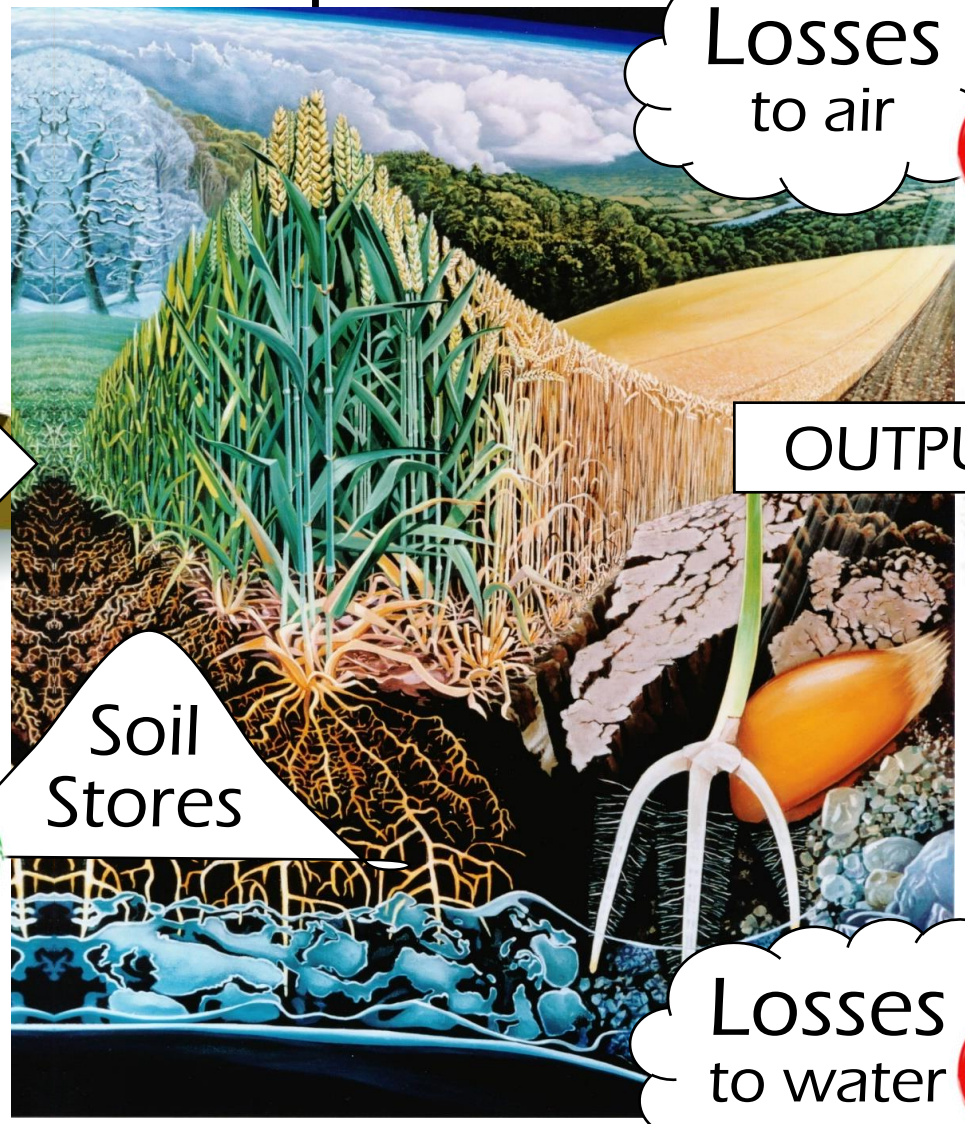
Management: Crop Nutrition

INPUTS



Losses to air

OUTPUTS

?

Soil Stores

?

Losses to water

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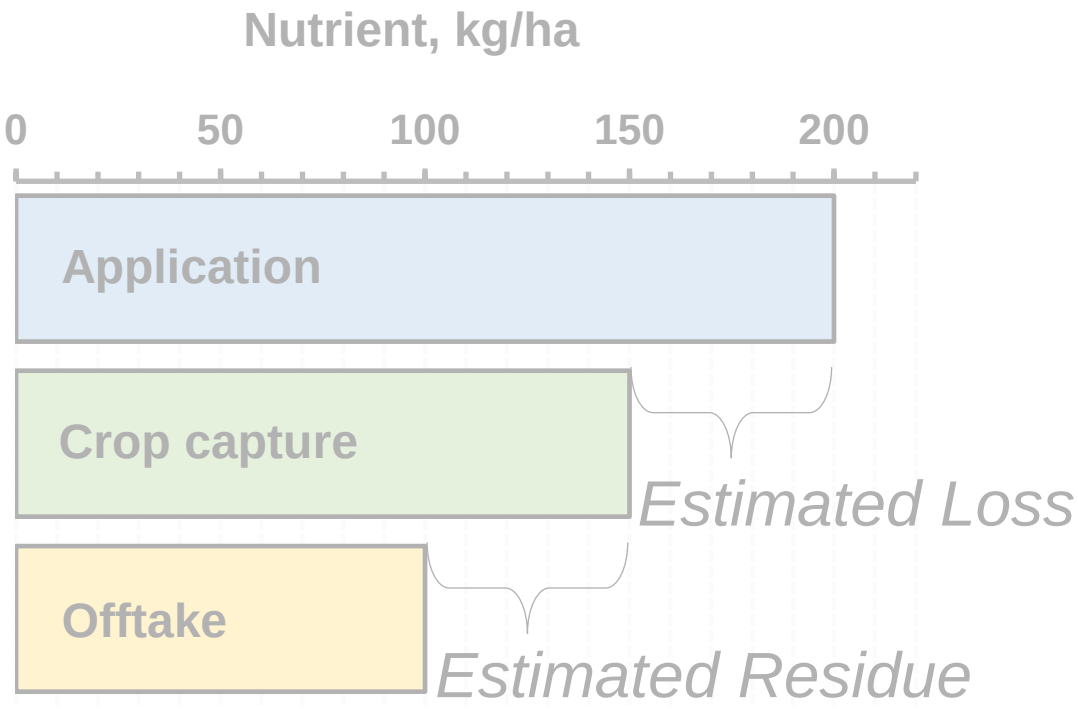
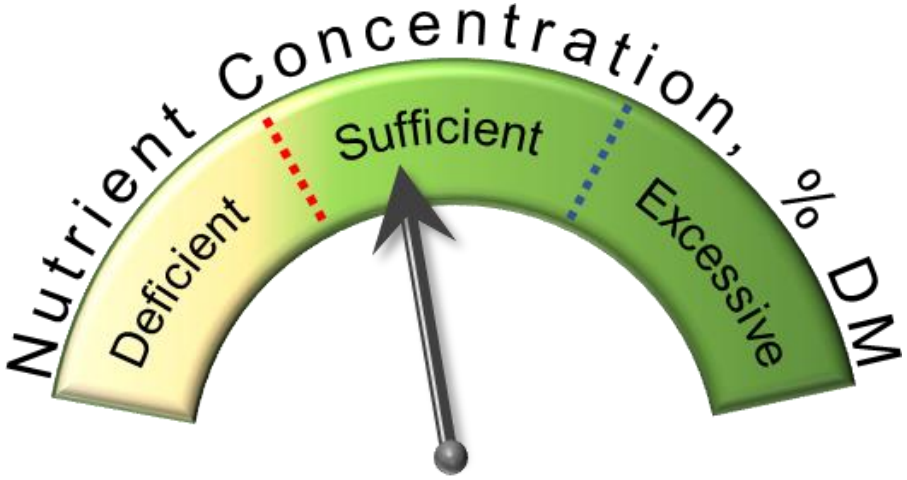
HARVEST ANALYSIS … Two Aims

1. Balances & Efficiencies



2. **Diagnosing final Deficiencies** *or* **Excesses**



Nutrient offtake =

x

Suggested Field Nutrient Accounting

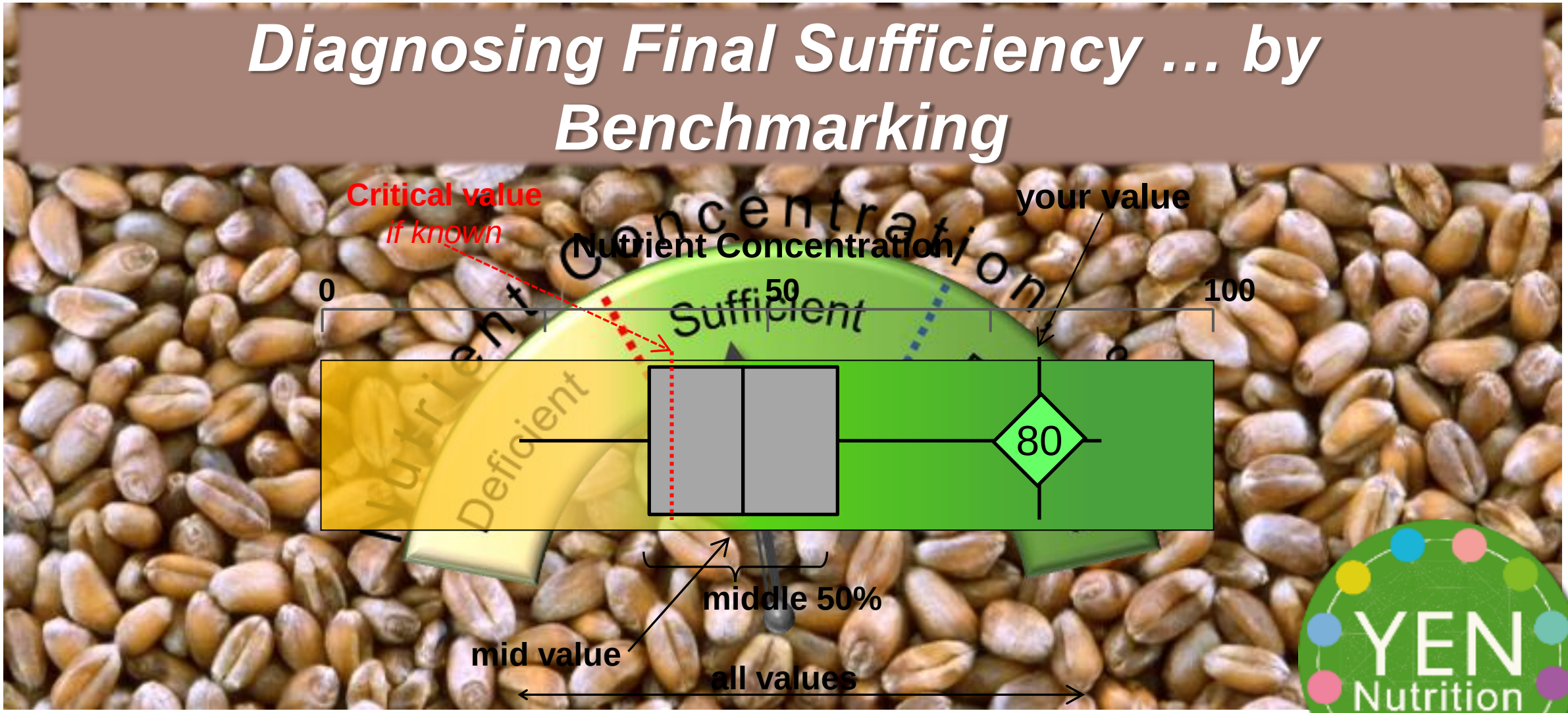
		Macro-Nutrients							Micro-Nutrients					
	units	N	P	K	Mg	S	Ca	*units*	Fe	Mn	Zn	Cu	B	Mo
1 **Demand budget** @ yield (t/ha) 6.5	*kg/ha*	135	20	90	15	15	15	*g/ha*	510	260	235	120	10	10
2 **Soil Supply**														
Soil analysis		-	23	307	280	-	-	*mg/l*	-	-	-	-	-	-
Soil Index	*Index*	-	2+	3	5	-	-	*Index*	-	-	-	-	-	-
3 **Total Nutrients Applied**	*kg/ha*	156	0	0	1	57	0	*g/ha*	0	3,000	0	0	>0	0
In Organic Manures (totals*)	*kg/ha*	0	0	0	0	0	0	*g/ha*	0	0	0	0	0	0
In Fertilisers & Sprays	*kg/ha*	156	0	0	1	57	-	*g/ha*	-	3,000	-	-	Yes	-
4 **Crop Capture** with yield (t/ha) of 7.5	*kg/ha*	189	50	121	19	39	13	*g/ha*	463	241	353	148	8	15
Demand difference from b		54	+30	+31	+4	+24	-2	*g/ha*	-48	-19	+118	+28	-2	+5
5 Leaf analysis at Growth Stag		63	0.38	2.12	0.14	0.37	0.76	*ppm*	116	67	21	6	8.6	1.5
Grain analysis		30	0.30	0.51	0.11	0.13	0.03	*ppm*	32	21	39	5	0.9	0.8
6 Harvest offtakes		68	20	66	9	12	8	*g/ha*	335	187	302	91	7	10
Soil Nutrient Balance	*kg/ha*	-12	-20	-66	-9	45	-8	*g/ha*	-335	2,813	-302	-91	NA	-10
All values are for elements. For Oxides (e.g. P_2O_5) multiply by:		1.0	2.3	1.2	1.7	2.5	1.0		1.0	1.0	1.0	1.0	1.0	1.0

! Analysis

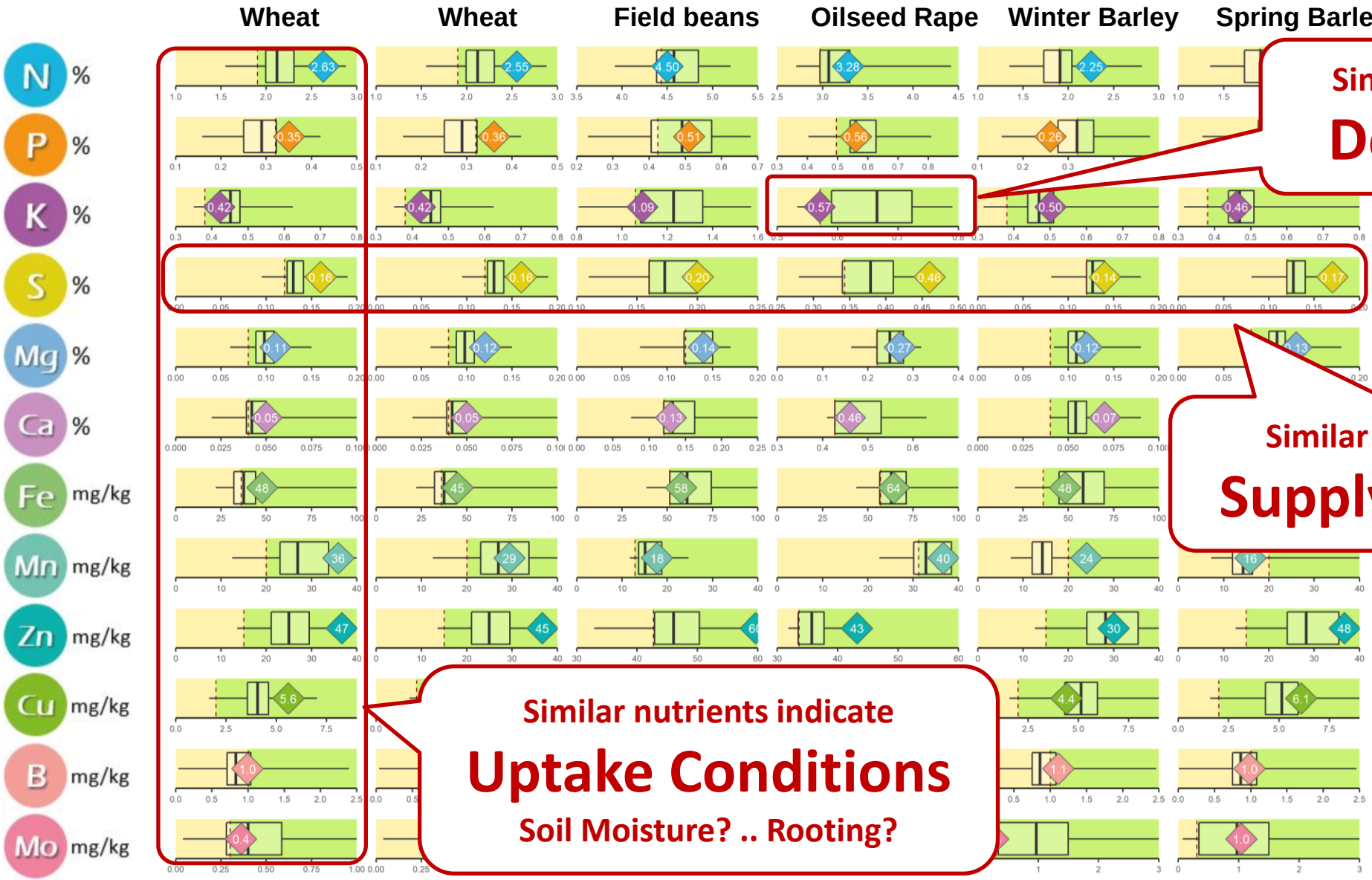
! Analysis

! Analysis

Evaluating Nutrient Concentrations:



Example Grain Nutrient Benchmarking report

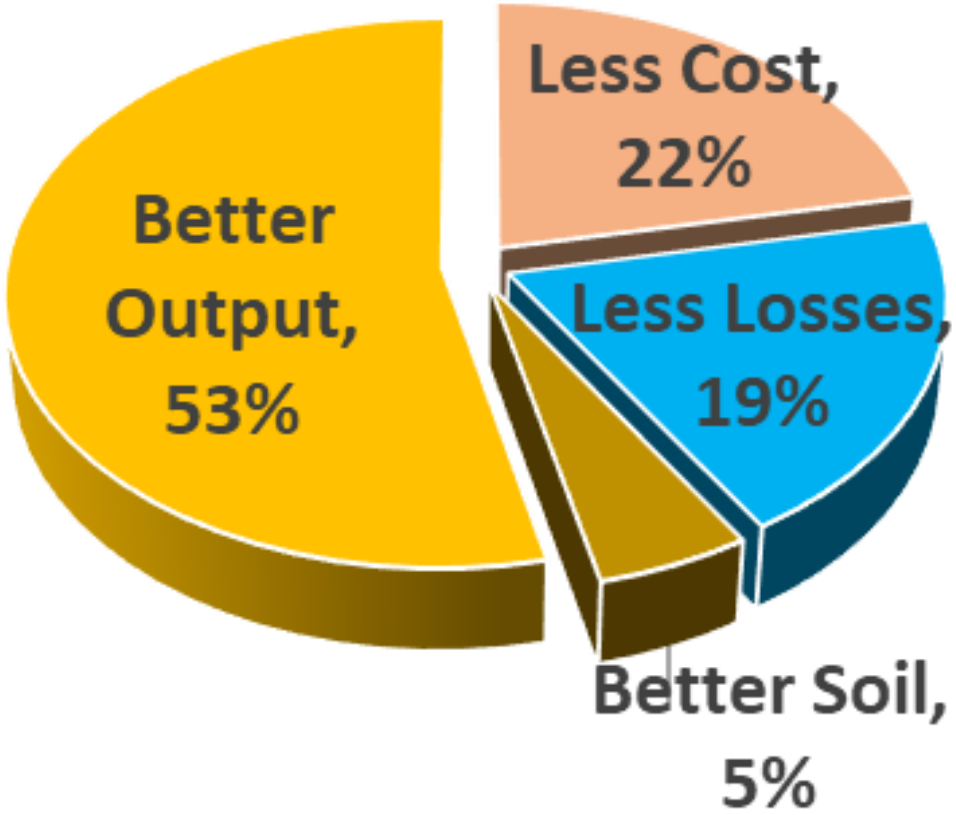


Harvest Analysis supports Farm Learning:

from last year to the next

UK Farmers' & Advisors' –

Main aims of crop checking:



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OPTIMISING CROP NUTRITION

Harvest Analysis is new: *it needs collaboration*

ADAS

Delphy

Agricultural University of Athens

Lithuanian Agricultural Advisory Service

ARVALIS Institut du végétal

LAMMC Lithuanian Research Centre for Agriculture and Forestry

CDR

SEGES

consulai

eagasc Agriculture and Food Development Authority

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Summary: UK conclusions

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OPTIMISING CROP NUTRITION

Any Manager must check OUTPUTS as well as INPUTS

- Farms do check fertilisers .. they must also check ORGANIC INPUTS
- Plus **Nutrient Harvests**

Nutrient HARVESTS vary a lot: CHECKS are ESSENTIAL

- Soil, leaf, & canopy checks are helpful, but secondary to final outputs

Accurate harvest checking requires laboratory ANALYSIS & BENCHMARKING:

Farms must accept cost, & data sharing

- Cereals, Oilseeds & Pulses validated in UK
- Potatoes or Maize .. to be validated.

Cost = €0s / field
Average **Value =**
€000s / field !

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ADAS

Thank you

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