

An aerial photograph of a large agricultural landscape. In the foreground, several fields are visible, some with distinct crop patterns and others showing signs of harvesting. Two agricultural vehicles are present: a yellow combine harvester on the left and a green tractor on the right. The fields are bordered by a dense line of trees. In the background, a wide river or estuary flows towards the horizon under a clear sky.

Using UAS and remote sensing in Danish national trials

The 4th Annual – Nordic Plant Phenotyping Network Workshop,
November 22nd – 23rd, 2018

Lars Bonde Eriksen, Senior Specialist

SEGES



Biomass measurements from drone and satellite

- Farmers union trials
- Biomass measurements in trials
- Measurement from satellite and use in farming

Field trials organised by SEGES

- 1000 trials per year
 - Variety trials = 400
 - Fertilizer trials = 240
 - Plant Protection = 260
 - Miscellaneous = 100
- Results published in December
- Distributed between 13 local trial units

SEGES



Raw data is published online in the season

Nordic Field Trial System Version: 1.0.0.10423

[Forsøgsdokumentation](#)

011051515-001. Vårbygsorter, A og B sorter

Resultater fra Landsforsøgene må kun anvendes under særlige betingelser – læs [her](#)

Forsøgets placering

Forsøgvært: Ove Ehlersen
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8200 Århus N
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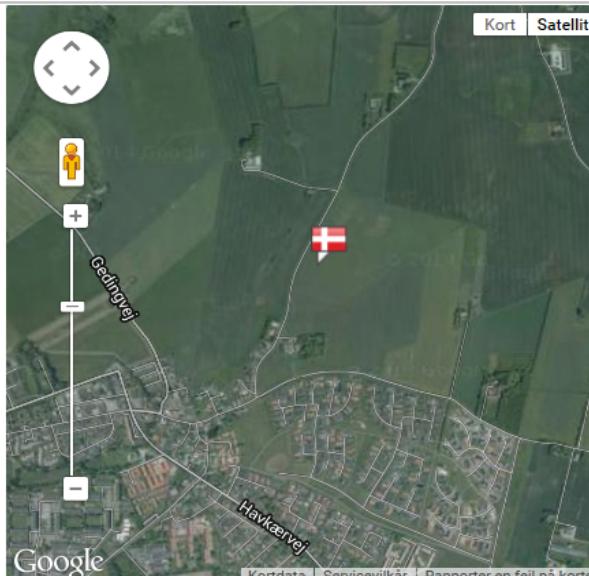
Konsulentnummer: 1417
Placeringsgruppering: Østjylland
Placing:
Utm Zone: 32
Easting: 569.472 m
Northing: 6.228.656 m
Gps: 56.1977763227044, 10.119659480891
Komune:

[Eksporter enkeltforsøgsdata til XML](#)
[Komprimeret dokumentation](#)
[Forsøgsdesign og randomiseringsplan](#)

Grundoplysninger
Afgrøde: Vårbyg. Forfrugt: Vårbyg.
Forsøgstype: Alpha-design, 1 faktor. Antal gentagelser: 4. Antal rækker: 4.

Grundbehandlinger

Dato	Mgd/ha	Kategori	Middel	Total N/ha	P/ha	K/ha	Bl	Omfang
10-04-2015		Udsæd og såning	Så-dato, hovedafgrøde					Både mark og forsøg
10-04-2015	550 kg	Handelsgødninger	NPK 21-3-10 m Mg S B	113,3	14,3	52,8		Kun forsøg
18-05-2015	0,6 l	Herbicider	Tomahawk 180 EC				0,86	Både mark og forsøg
18-05-2015	15 g		Ally SX				0,75	Både mark og forsøg
04-06-2015	0,2 l	Fungicider	Prosaro EC 250				0,22	Både mark og forsøg



[Til Oversigt](#)  

 [Kortdata](#) | [Servicevilkår](#) | [Rapportér en fejl på kortet](#)



110% 

Biomass measurements from drone with multispectral camera



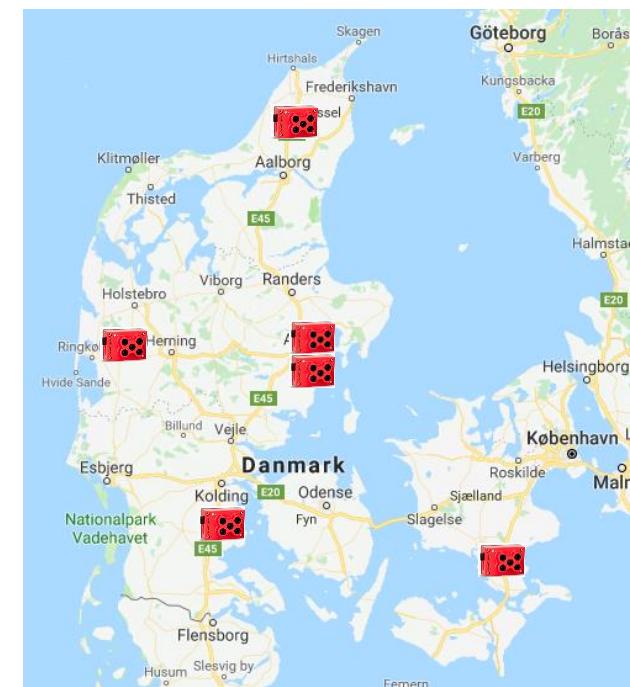
Micasense, RedEdge-M



Band Number	Band Name	Center Wavelength (nm)	Bandwidth FWHM (nm)
1	Blue	475	20
2	Green	560	20
3	Red	668	10
4	Near IR	840	40
5	Red Edge	717	10

$$NDVI = \frac{NIR - Rød}{NIR + Rød}$$

$$NDRE = \frac{NIR - RedEdge}{NIR + RedEdge}$$



Biomass measurements from drone

Solvi | NJ_01154001_01153001 6 X +

https://solvi.nu/projects/1604

Mest besøgte Forsøgsøkonomi SEGES DMI NFTS NaturErhverv PVO S

NJ_01154001_01153001 ...

ORTHO PHOTO ANALYSIS & PRESCRIPTION EXPORT

ORTHO PHOTO

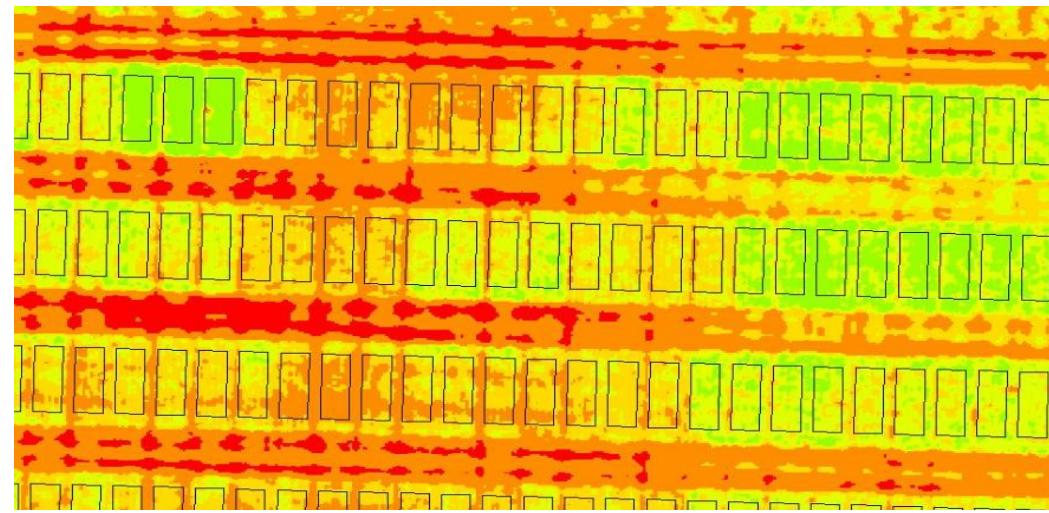
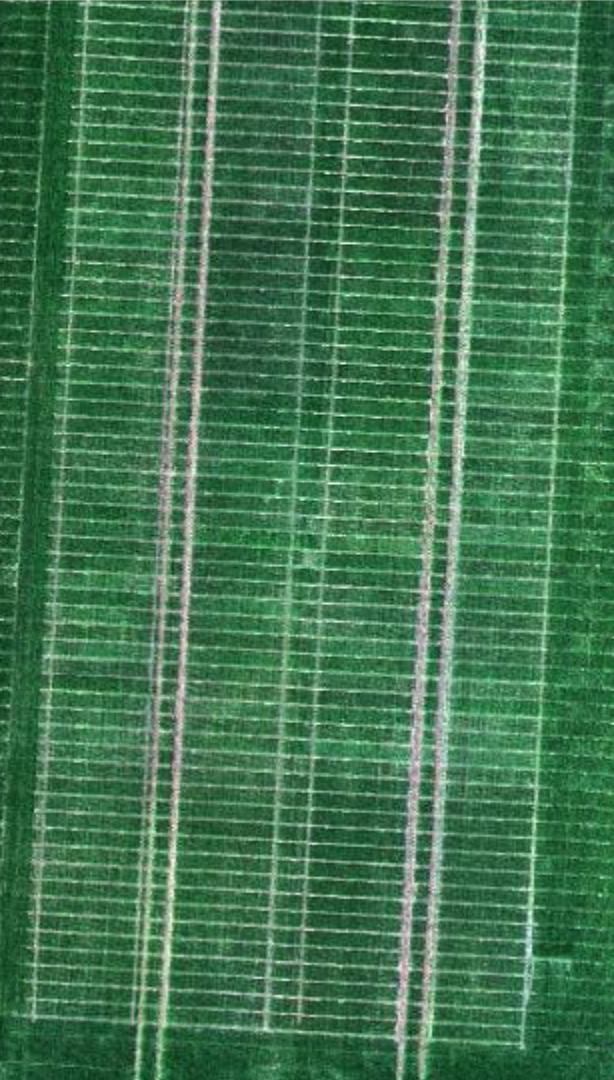
6 MAY 2018

ELEVATION NEW

CROP

MEASURE AREA

MEASURE DISTANCE



Observerede rå-data og modelkontrol

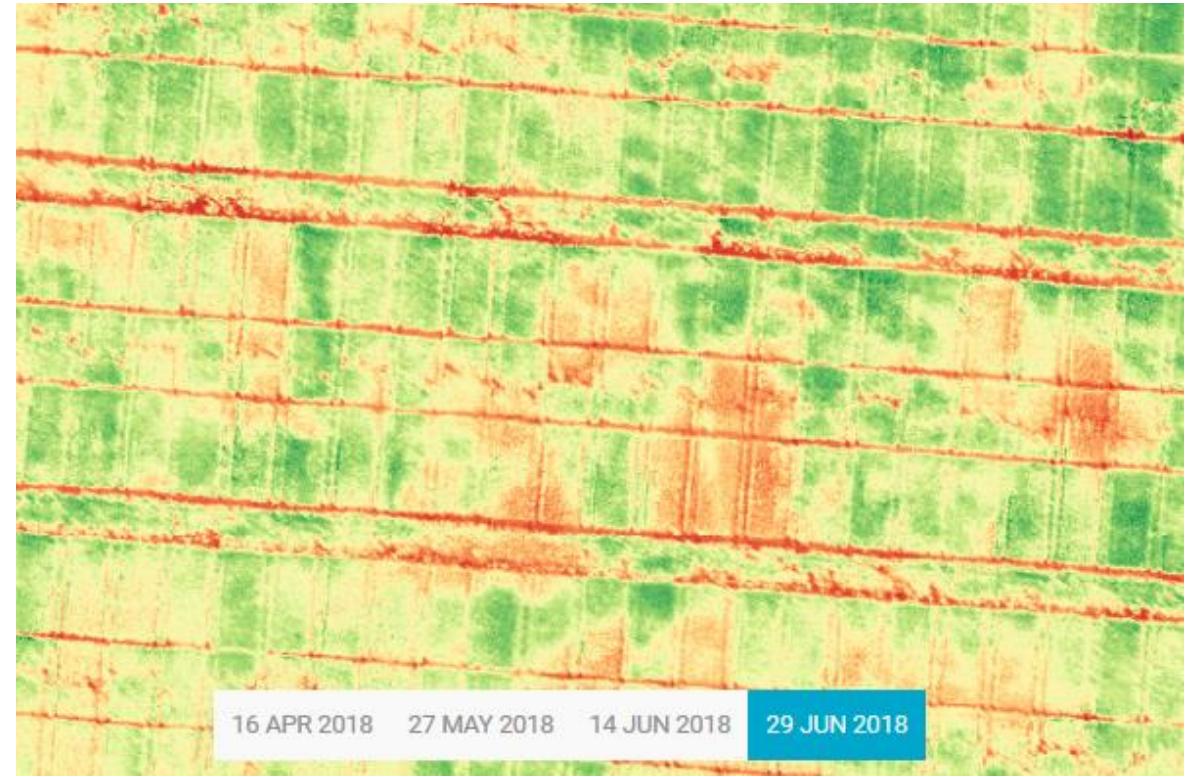
P06:

25-11-2017 ST.

			NDVI-REFLEKTANS værdi	Nedre konf.	Øvre konf. int.	Signifikansgruppe
I	A	1	0,32568	0,3	0,4	ab
		2	0,24864	0,2	0,3	ce
		3	0,33922	0,3	0,4	a
	B	1	0,15869	0,1	0,2	gi
		2	0,20258	0,2	0,2	fh
		3	0,20881	0,2	0,3	dfh
II	A	1	0,26853	0,2	0,3	bcd
		2	0,35225	0,3	0,4	a
		3	0,34672	0,3	0,4	a
	B	1	0,18428	0,1	0,2	hi
		2	0,22681	0,2	0,3	ef
		3	0,22035	0,2	0,3	efg

LSD

Måletid	Dato	Måling af	
P06	25-11-2017	NDVI-REFLEKTANS, værdi	lsd1=0,01384 p1=0 lsd2=0,02478 p2=3E-05 lsd3=0,02035 p3=0,00012 lsd4=0,01512 p4=0 lsd5=0,01512 p5=0 lsd6=0,01512 p6=0 lsd7=0,01512 p7=0 lsd8=0,01512 p8=0 lsd9=0,01512 p9=0 lsd10=0,01512 p10=0 lsd11=0,01512 p11=0 lsd12=0,01512 p12=0 lsd13=0,01512 p13=0 lsd14=0,01512 p14=0 lsd15=0,01512 p15=0 lsd16=0,01512 p16=0 lsd17=0,01512 p17=0 lsd18=0,01512 p18=0 lsd19=0,01512 p19=0 lsd20=0,01512 p20=0 lsd21=0,01512 p21=0 lsd22=0,01512 p22=0 lsd23=0,01512 p23=0 lsd24=0,01512 p24=0 lsd25=0,01512 p25=0 lsd26=0,01512 p26=0 lsd27=0,01512 p27=0 lsd28=0,01512 p28=0 lsd29=0,01512 p29=0 lsd30=0,01512 p30=0 lsd31=0,01512 p31=0 lsd32=0,01512 p32=0 lsd33=0,01512 p33=0 lsd34=0,01512 p34=0 lsd35=0,01512 p35=0 lsd36=0,01512 p36=0 lsd37=0,01512 p37=0 lsd38=0,01512 p38=0 lsd39=0,01512 p39=0 lsd40=0,01512 p40=0 lsd41=0,01512 p41=0 lsd42=0,01512 p42=0 lsd43=0,01512 p43=0 lsd44=0,01512 p44=0 lsd45=0,01512 p45=0 lsd46=0,01512 p46=0 lsd47=0,01512 p47=0 lsd48=0,01512 p48=0 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SEGES

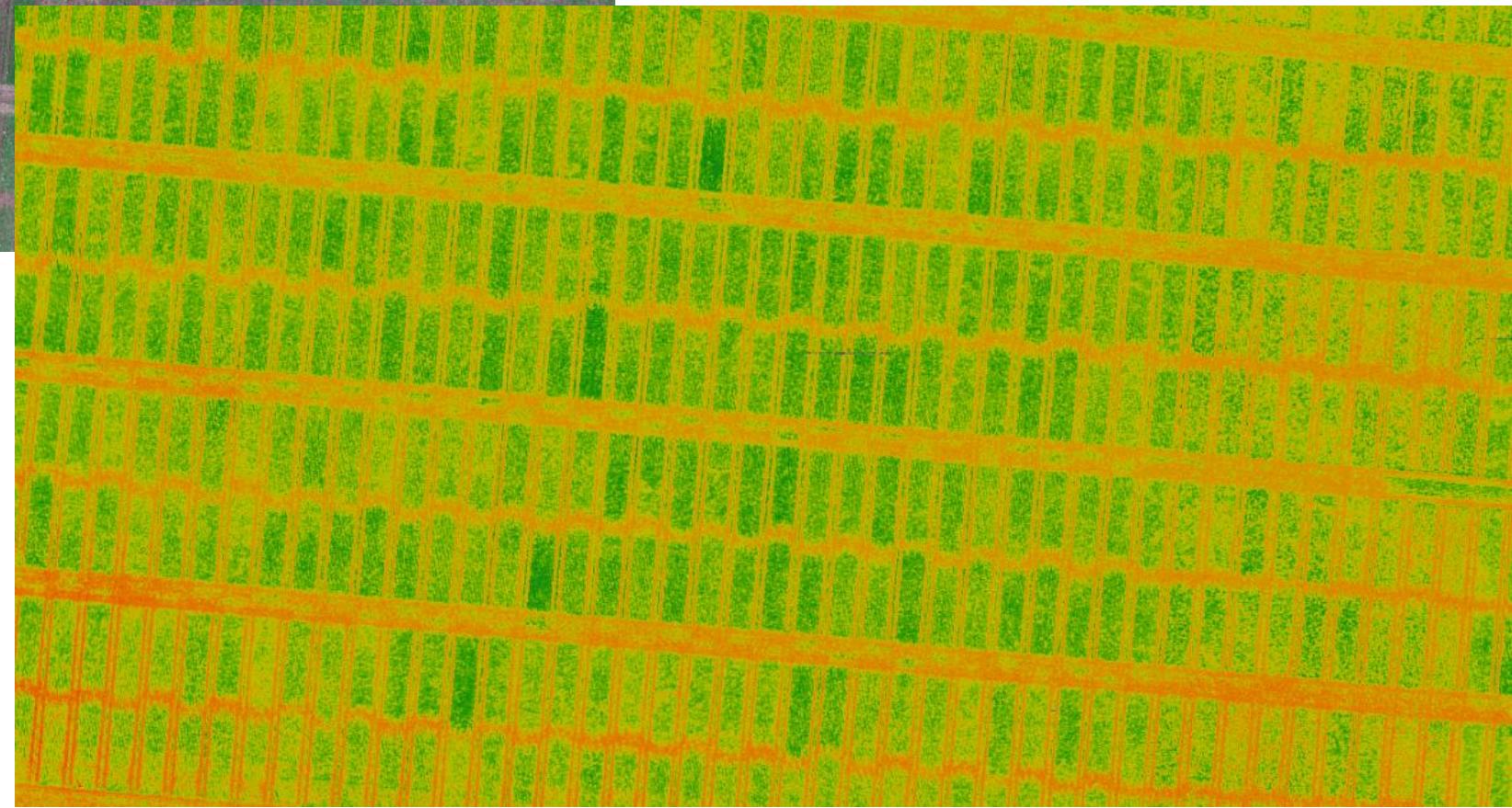


Application in trials

- Documentation of the trial
- Compare growth of different varieties:
 - Autumn growth
 - Speed of early spring growth
 - Earliness
- Nitrogen uptake
- Yield estimates

Winter wheat varieties

1. december 2017



SEGES

0,30

0,25

0,20

NDVI

0,15

0,10

0,05

0,00

KW 2616-14

Informer

SY Griffin

Creator

KM 15-25

KWS W308

RGT Universe

NOS 510050.19

KWS Nils

KWS Extase

KM 16-75

Johnson

KWS W320

SEC 87-09-1a

RW41640

Ohio

RW41667

KWS Leif

Hereford

LGW123

Terence

SEC 267-08-3

Kvium

Pirat

KWS Zyatt

Benchmark

LG Mocca

Kashmir

Chevignon

Viborg

Kvarn

KWS Talent

Graham

KW 4078-1-13

NOS 510037.5

SU Bungee

Hyking

Safari

RGT Bowen

KWS Lili

KWS W346

NOS 510032.7

Sj L262

LGWD14-4219-B

Kalmar

Baracuda

Elixer

NOS 509180.09

Blanding,vi-hved

LGWD 12-11289-D

NOS 509133.05

Drachmann

Kaldi

Pistoria

Canon

Sheriff

Galerist

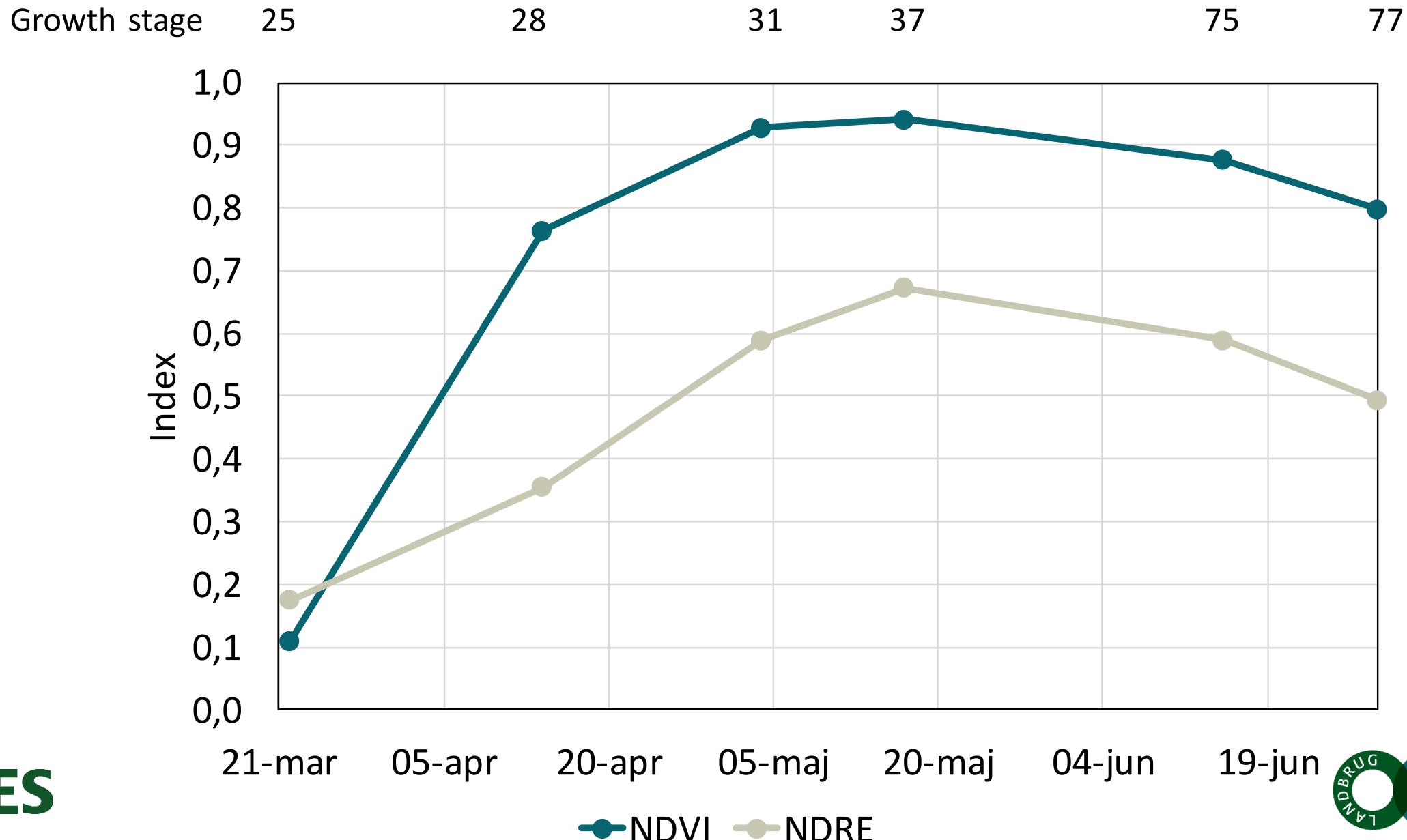
Torp

Hyvento

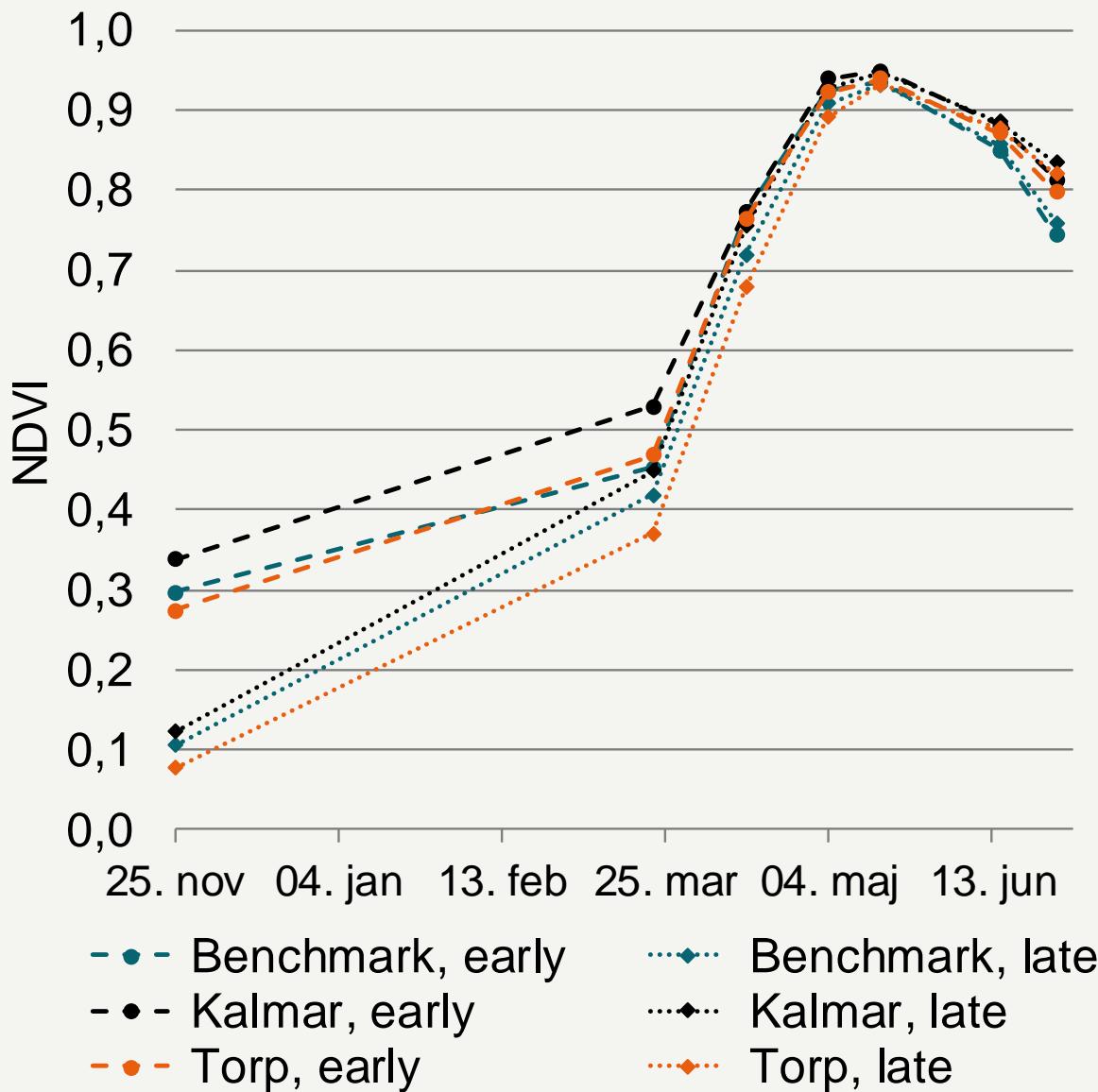
LSD95

Winter wheat variety trial 1. december 2017

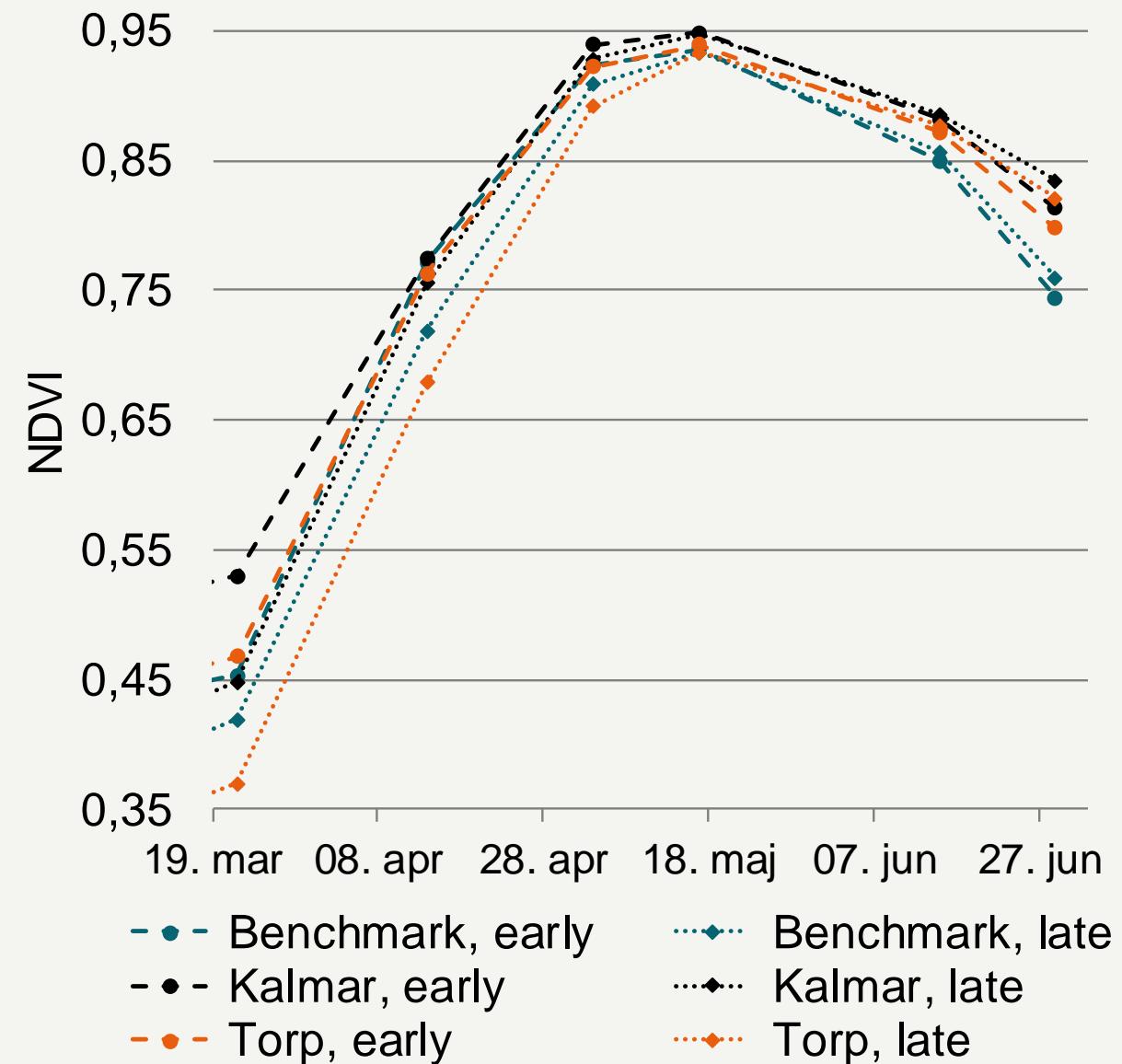
Vegetation index NDVI or NDRE, winter wheat

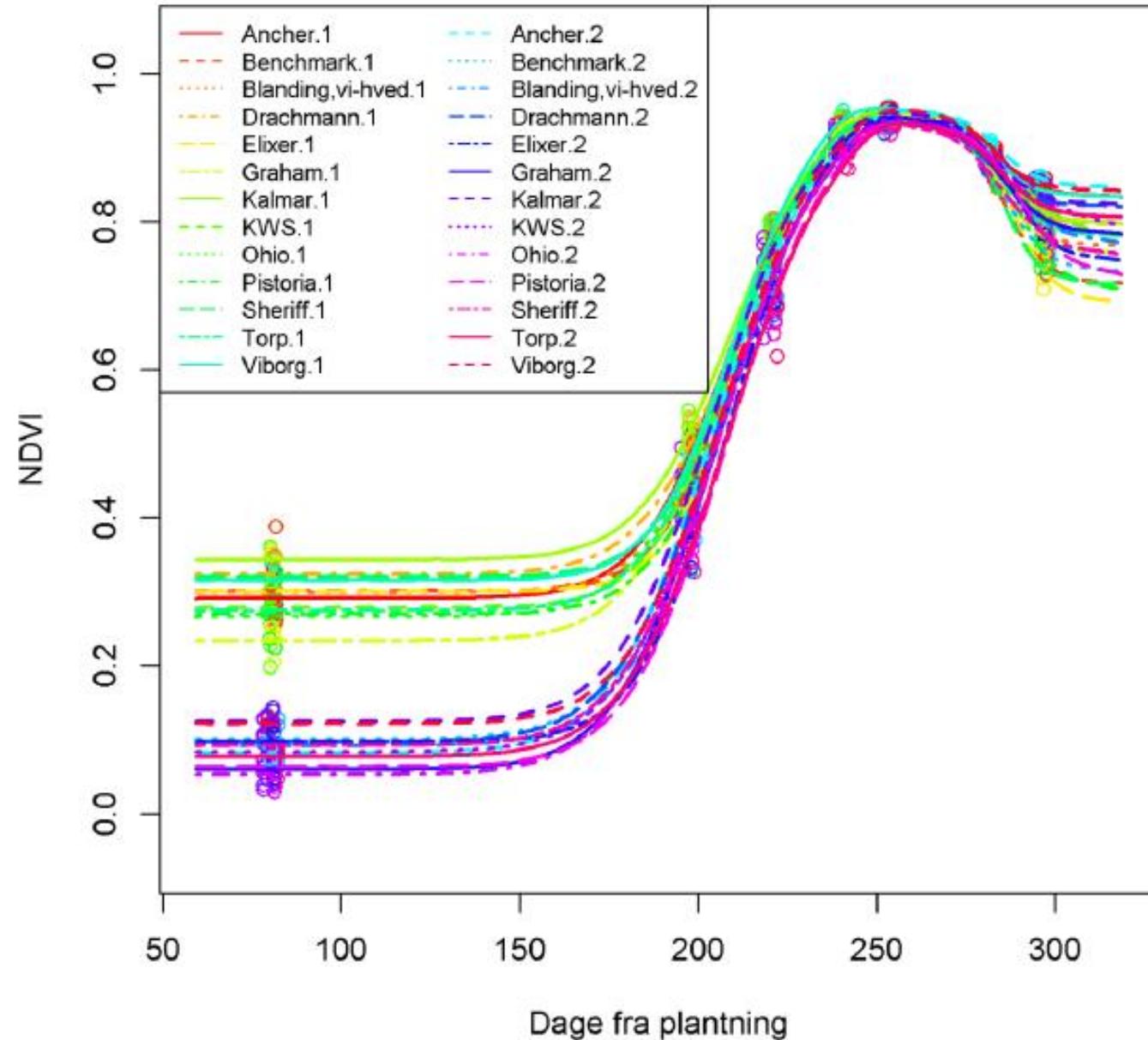


Varieties after early 5/9 and late 29/9 sowing



Varieties after early 5/9 and late 29/9 sowing

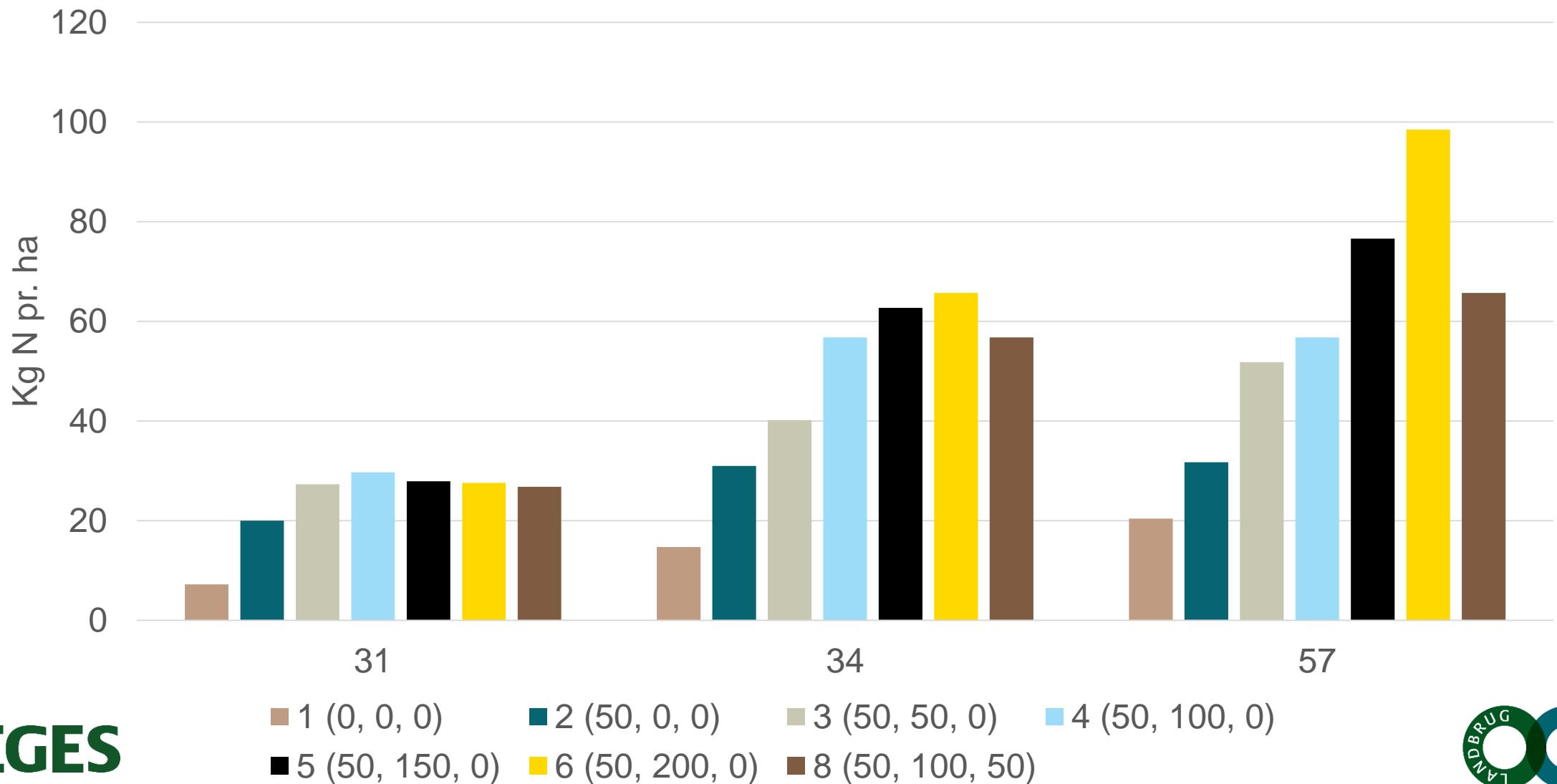




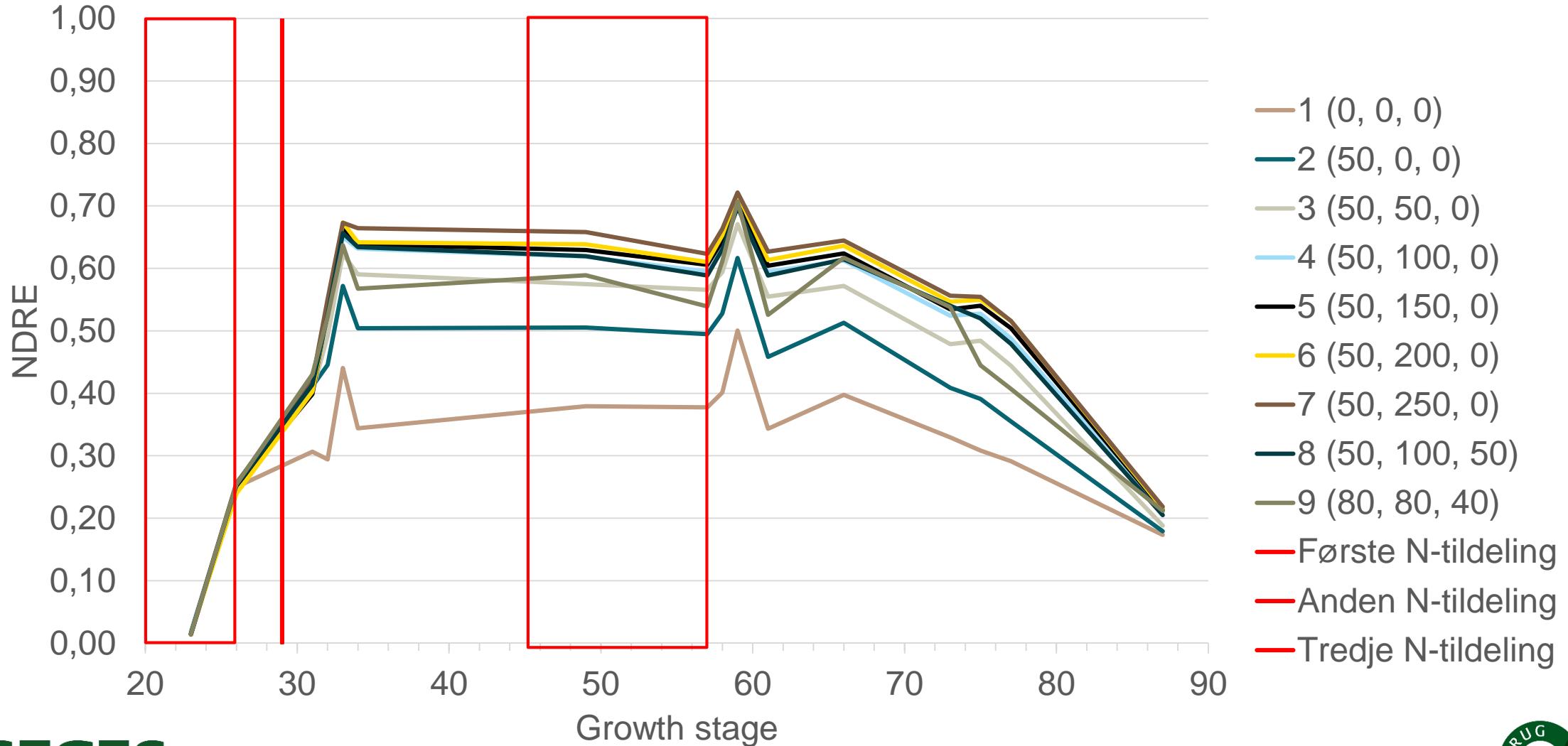
Parameter estimates from growth curves

Sowing date	Variety	Autumn growth	Max slope	Days to max slope
5. Sept.	Kalmar	0,34 a	-15,5 ab	211 abcd
	Torp	0,27 cde	-15,9 ab	211 abcd
	Benchmark	0,30 abcd	-18,8 b	212 abc
29. Sept.	Kalmar	0,12 f	-14,2 ab	206 d
	Benchmark	0,10 fg	-13,6 ab	208 bcd
	Torp	0,08 gh	-13,7 ab	210 abcd

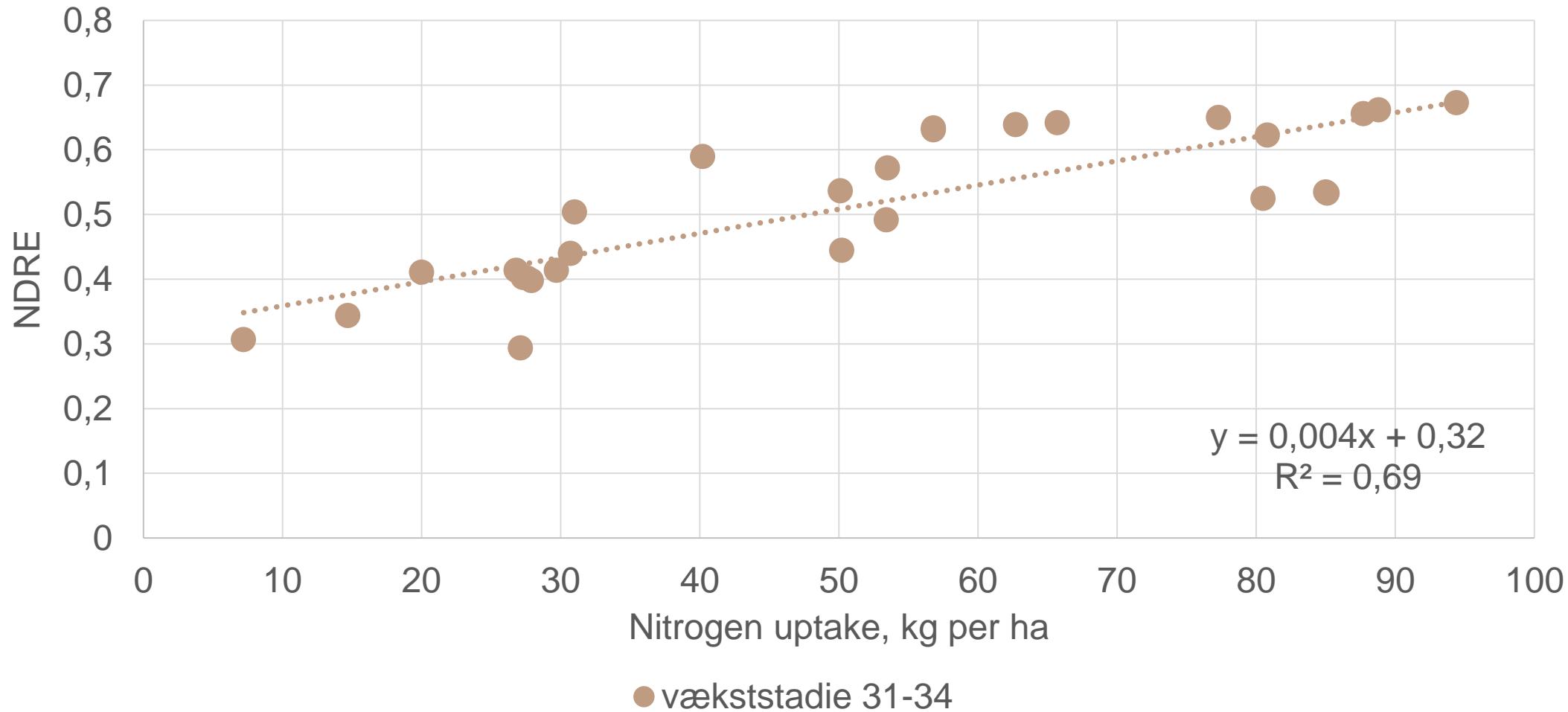
Fertilizer trials in wheat: Nitrogen uptake



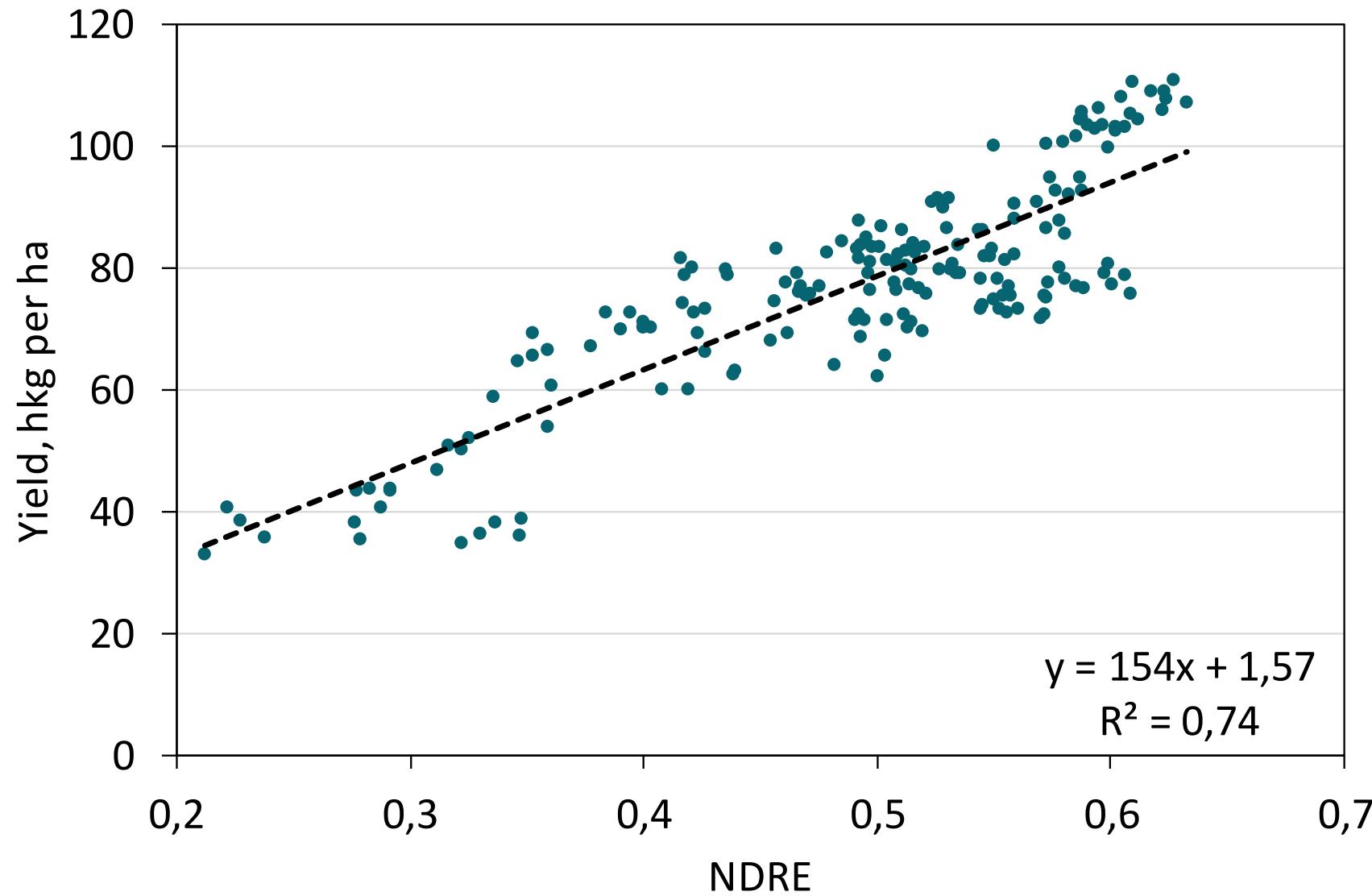
Fertilizer trials in wheat: NDRE index, 3 trials



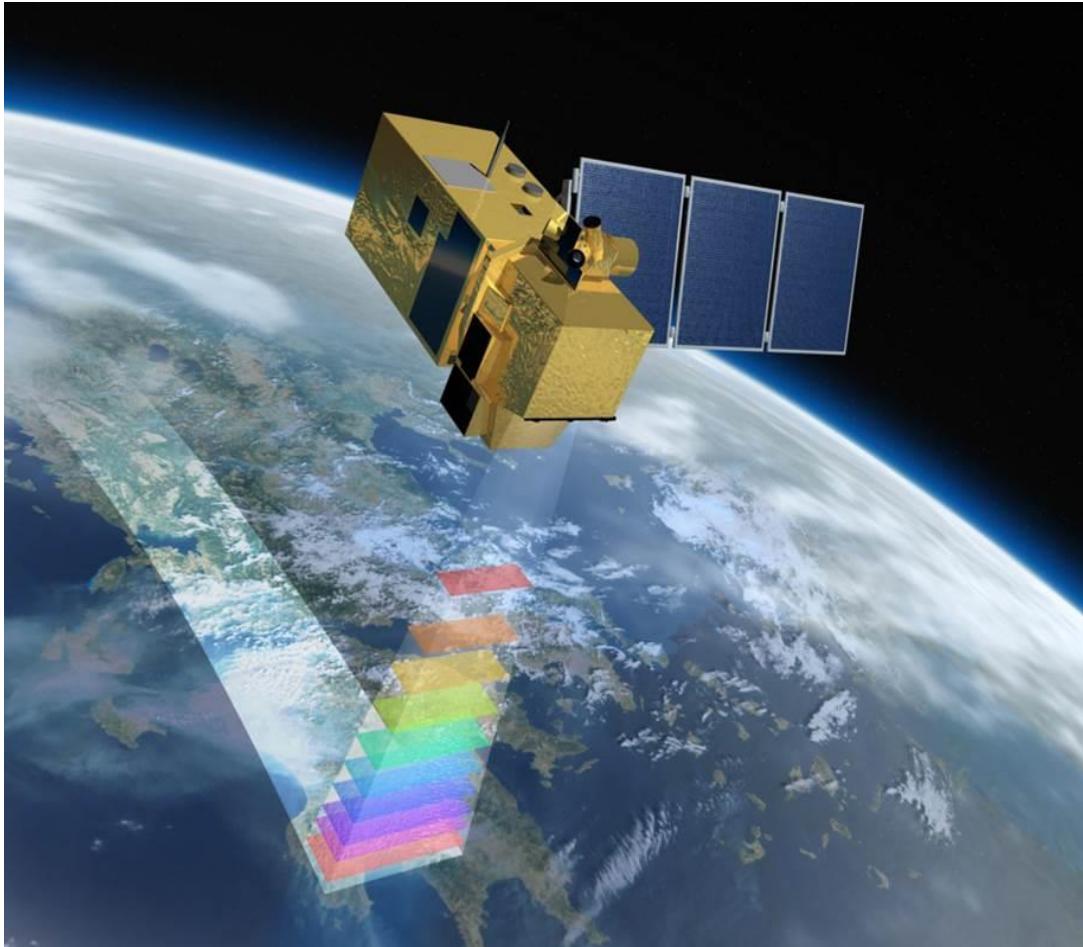
Fertilizer trials in wheat: Measured nitrogen uptake and NDRE



Fertilizer trials in wheat: NDRE GS 75 and grain yield

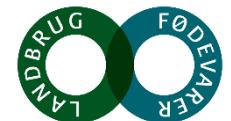


Sentinel 2 satellites

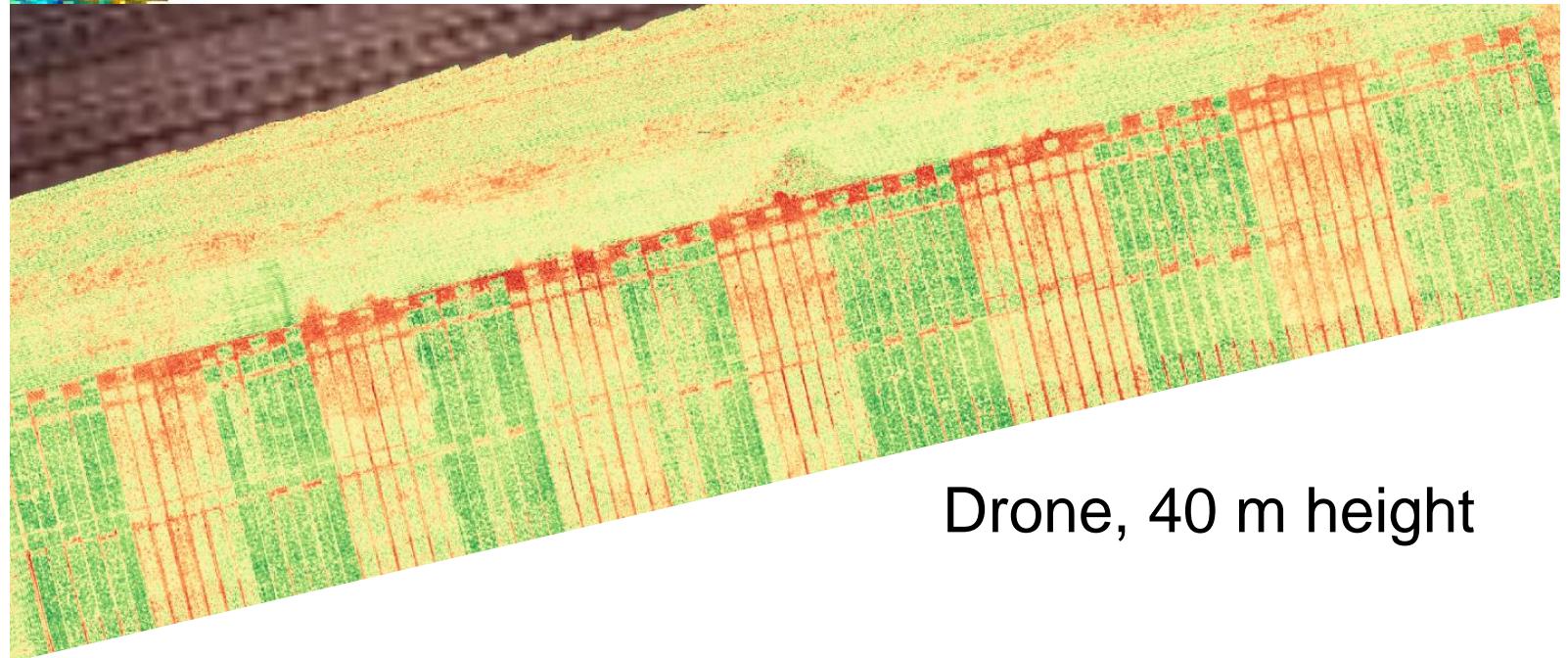
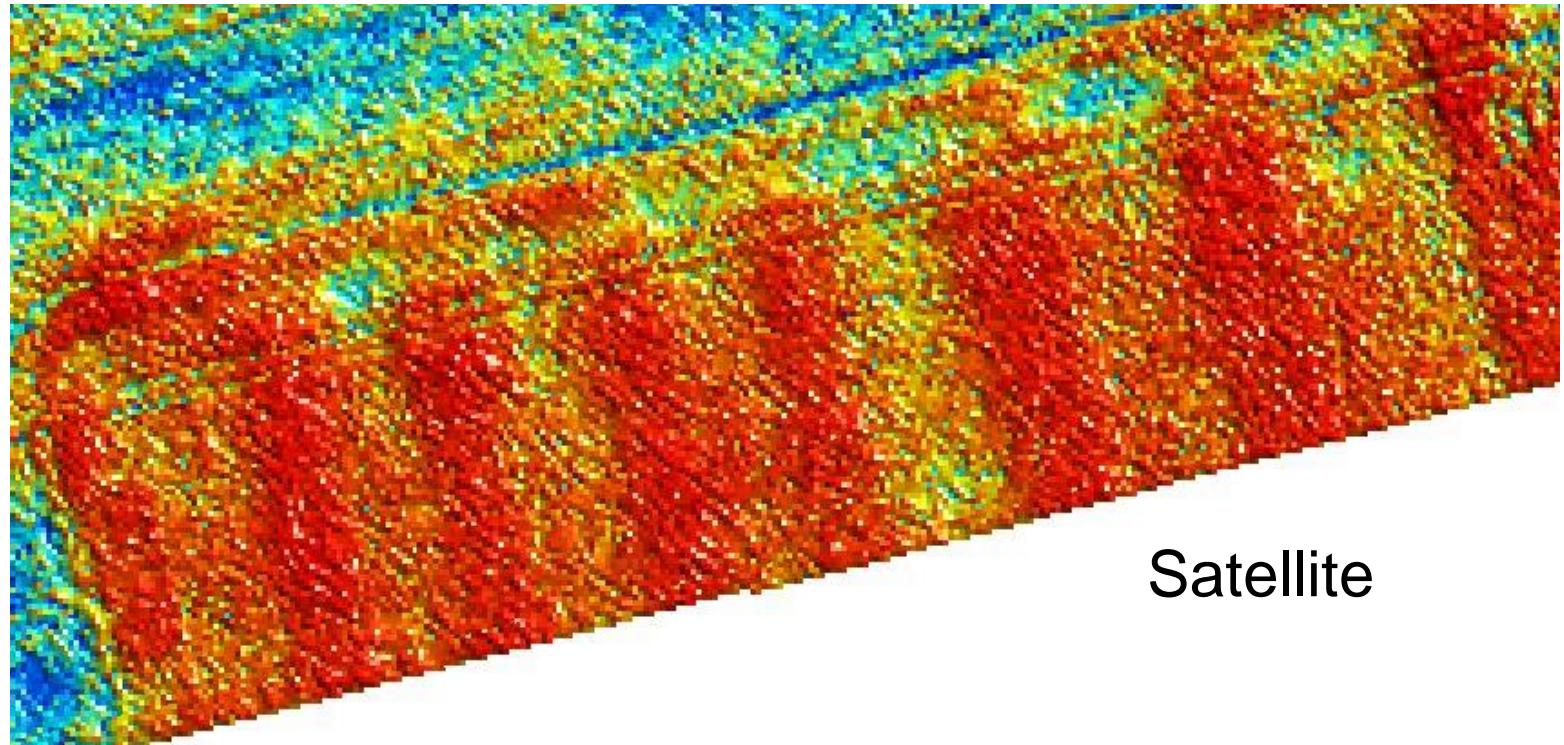


- Multispectral camera with 13 wavelengths 500 – 2.200 nm
- Resolution NDVI: 10 m, and NDRE: 20 m
- Denmark covered every 5 days

SEGES

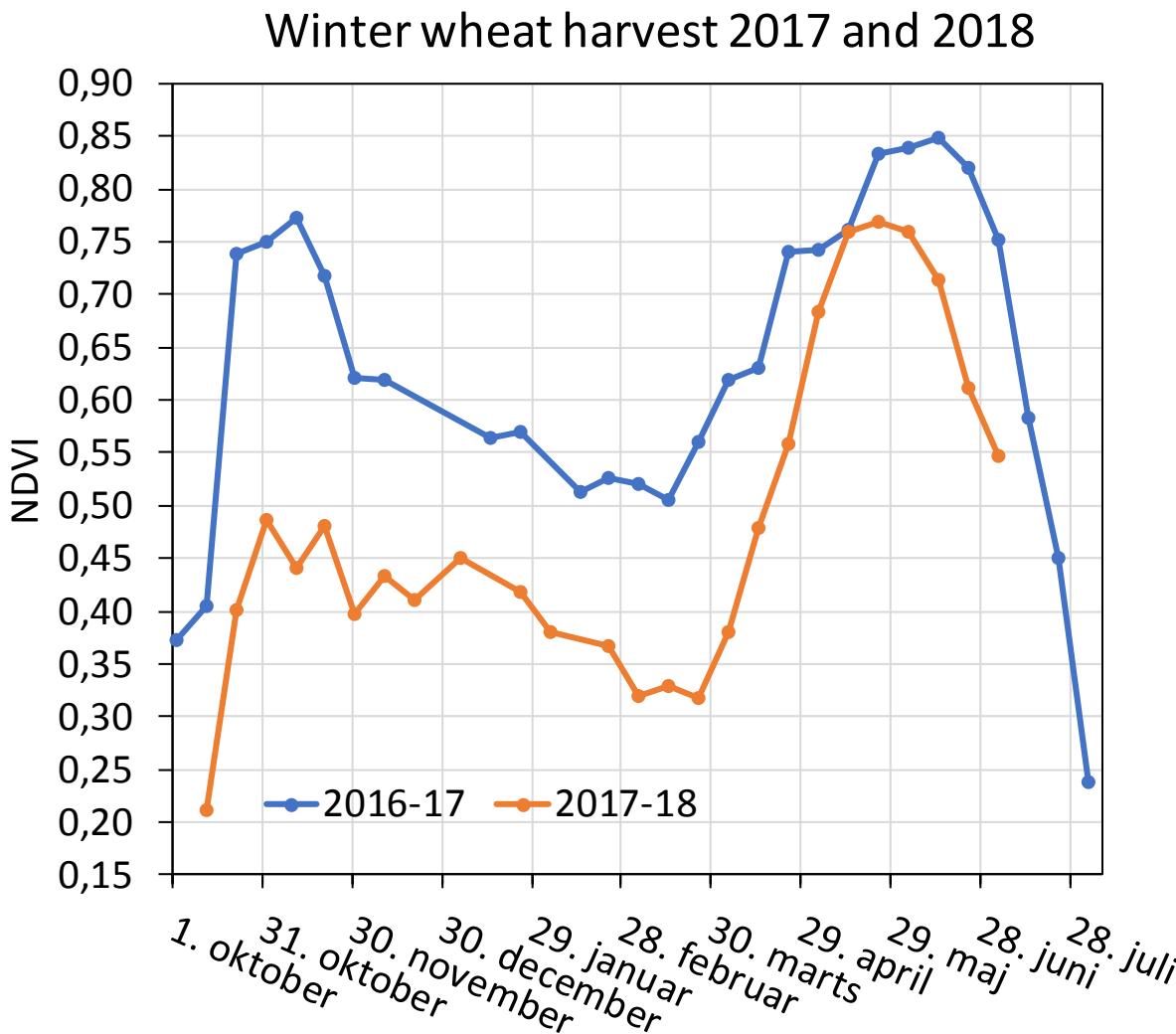


Commercial satellites with 40 cm resolution

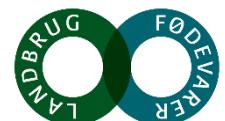
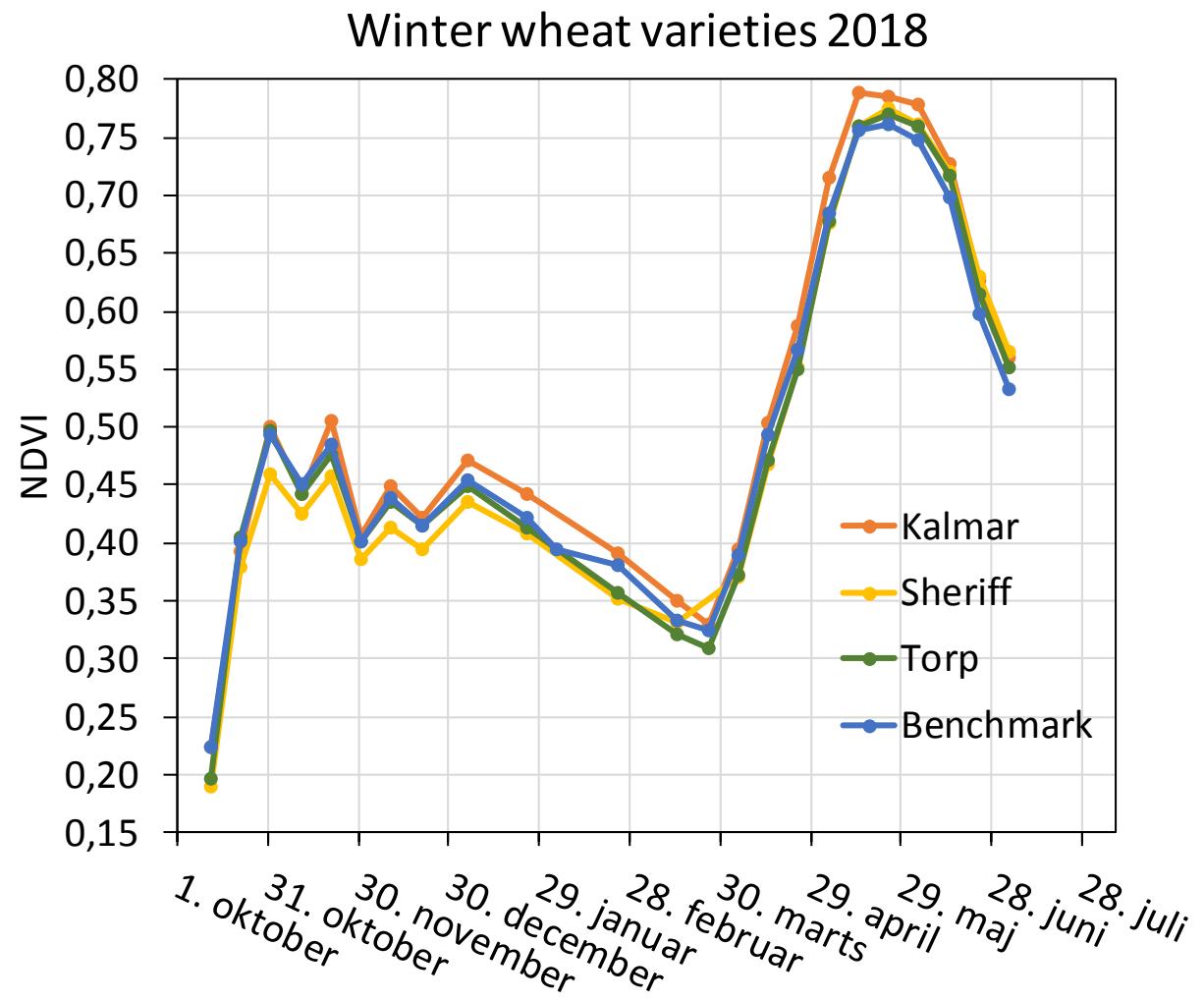


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Measurements of Danish wheat fields from satellite



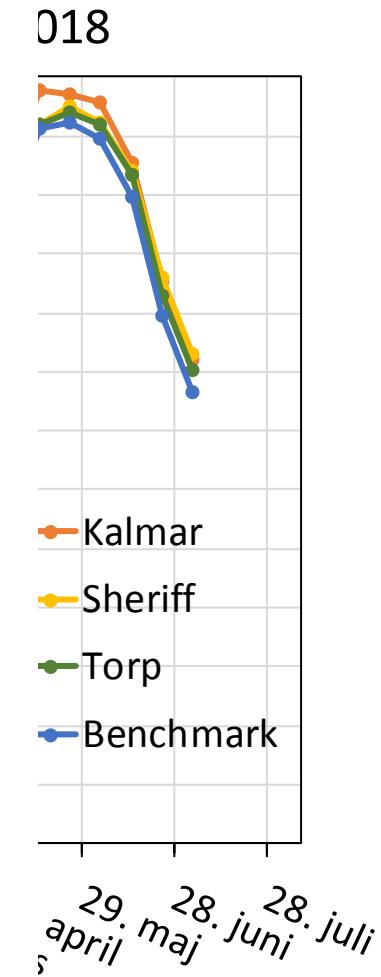
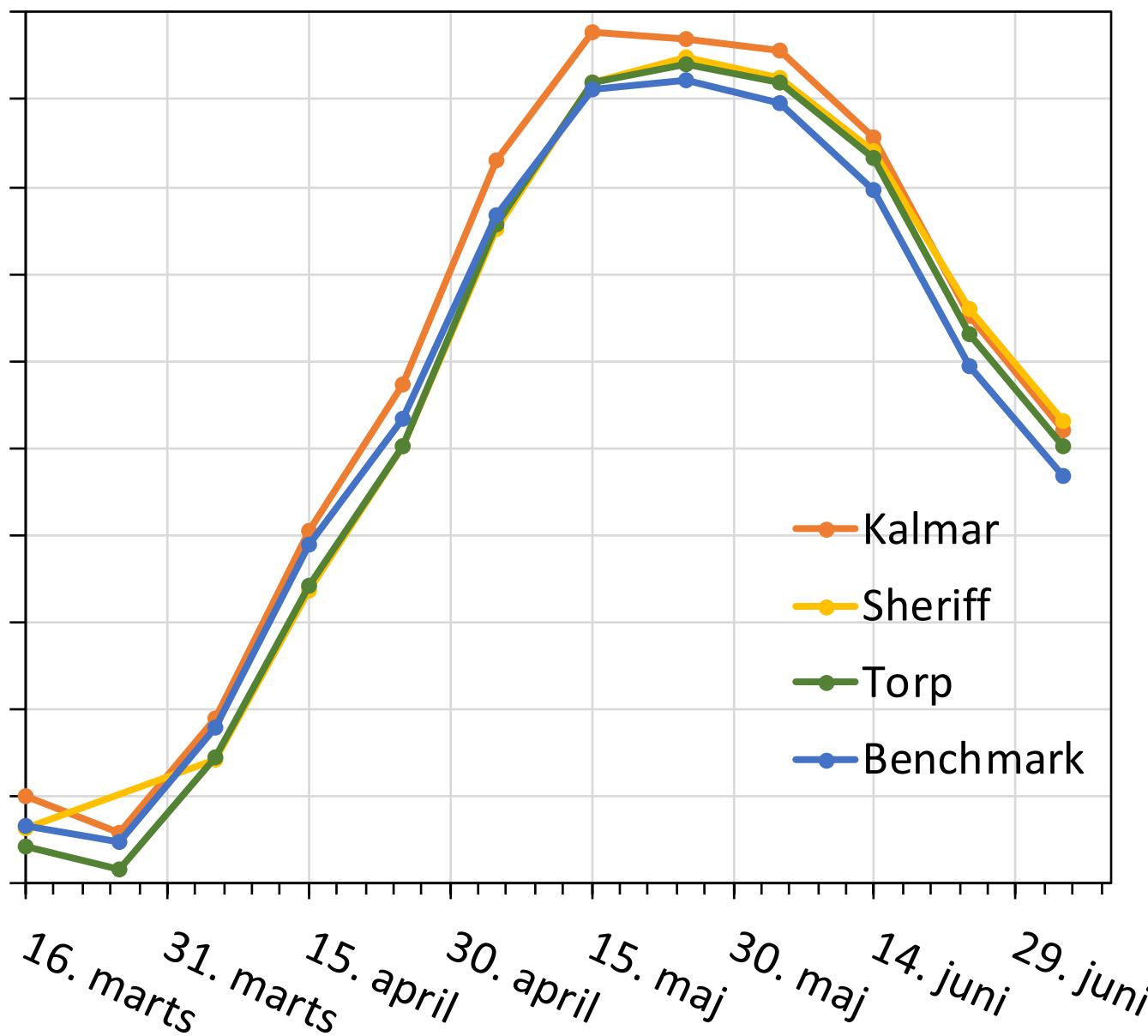
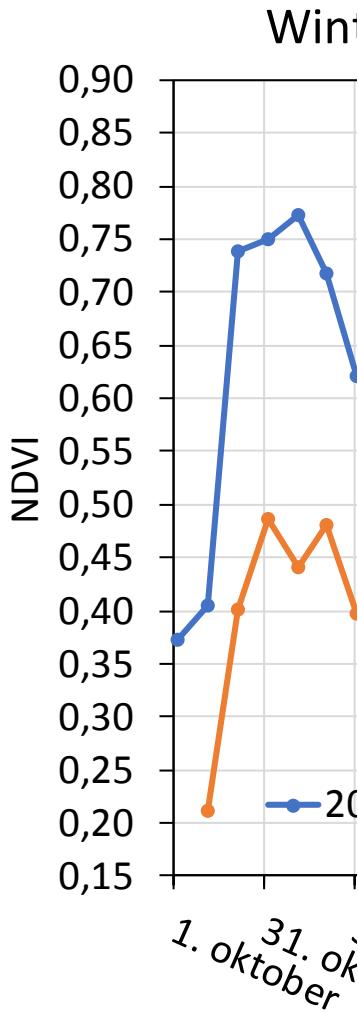
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Measures

SEGES

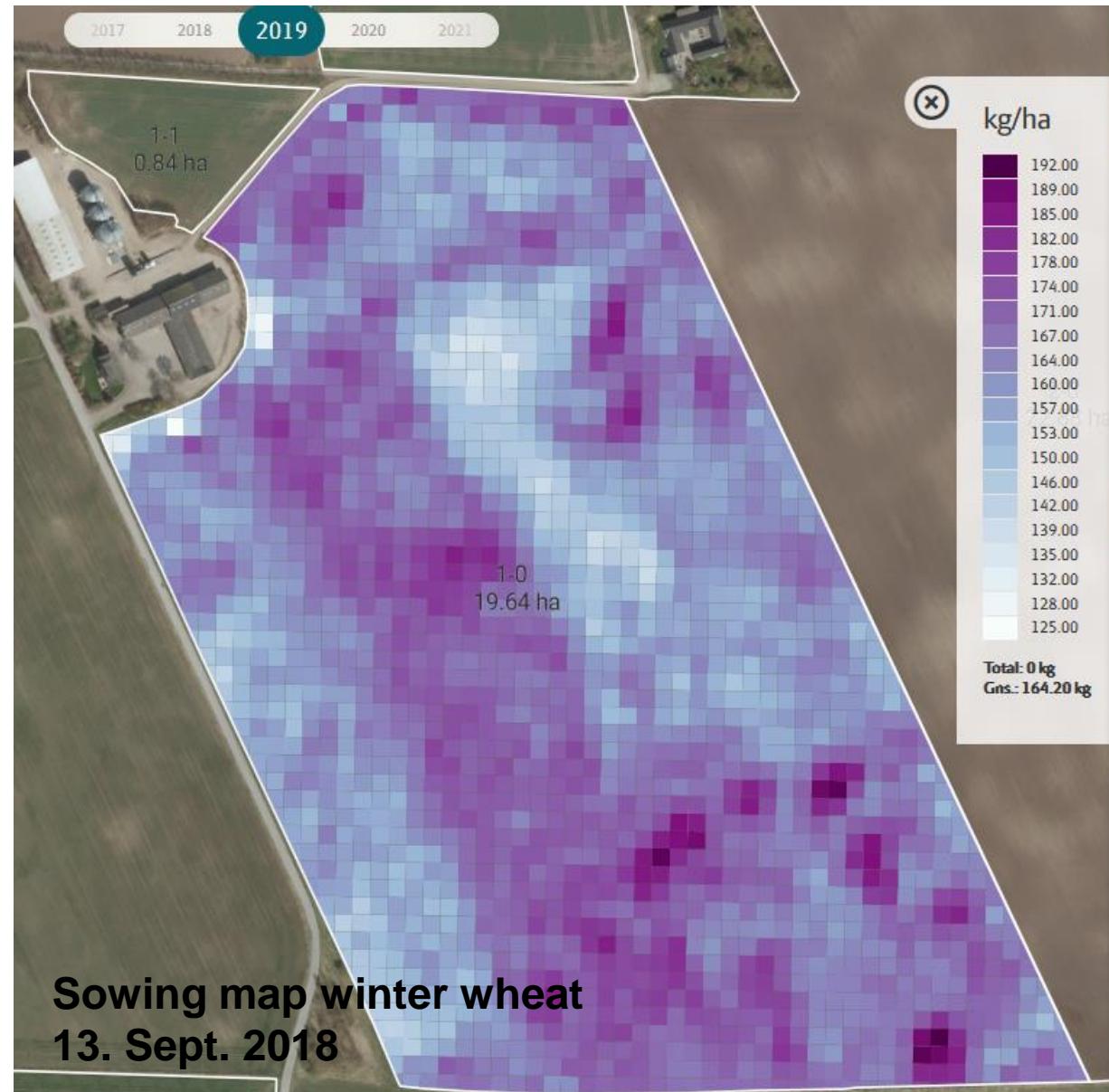
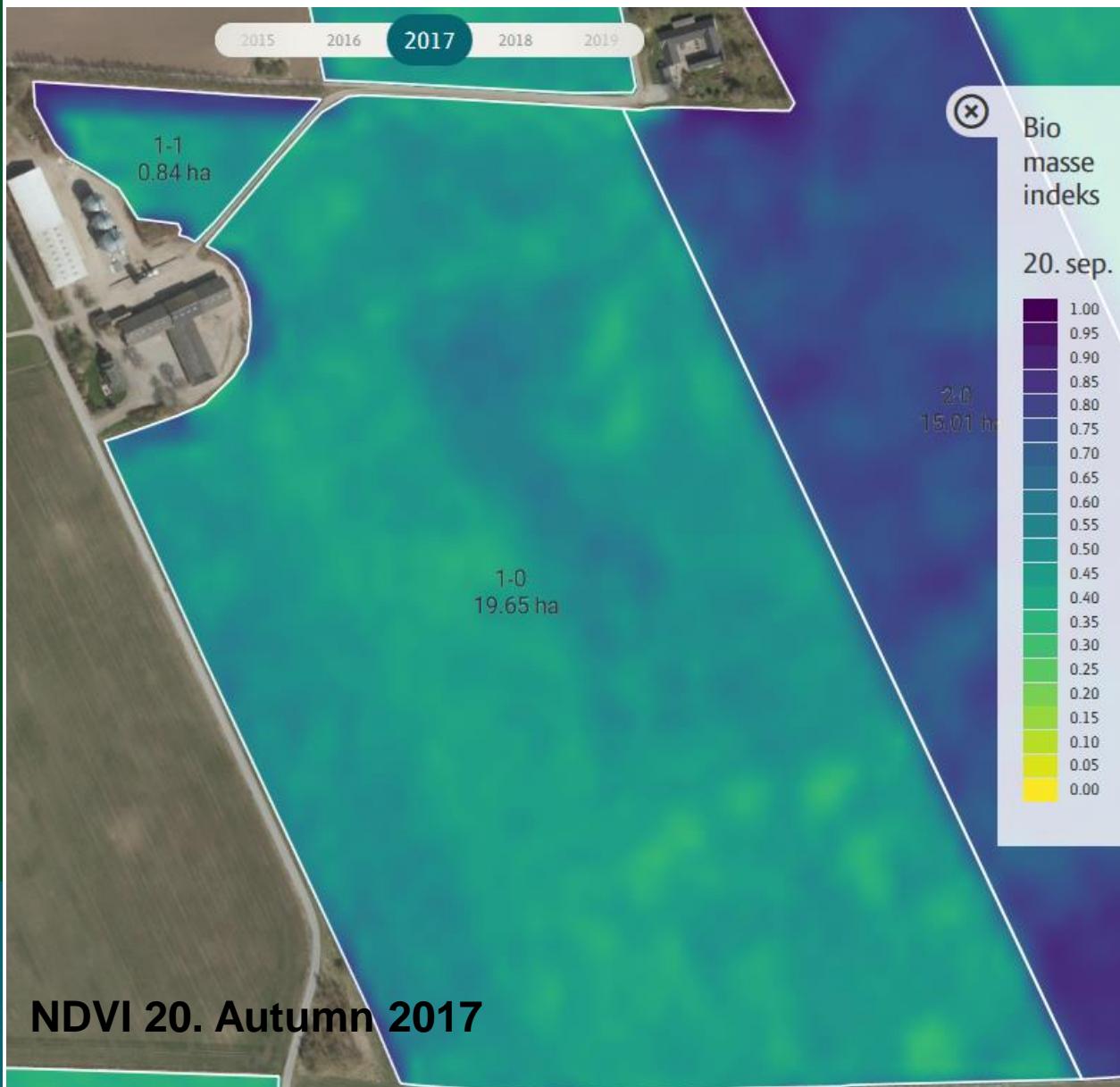
Winter wheat varieties 2018



NDVI on CropManager.dk



Precision farming, variable seed rates



Summary on the use of drone and satellite images

- Drone images:

- Document the quality of field trials
- Cultivar evaluation, growth habits
- Estimate of nitrogen uptake

- Satellite images:

- Crop analysis on field and country scale
- Precision agriculture, variable application of:
 - Nitrogen, Growth regulators, Fungicides, Seed