

Innovationer för hållbar växtodling

3d. Underlag för ett webbaserat beslutsstödssystem för precisionsodling



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3d. Underlag för ett webbaserat beslutsstödssystem för precisionsodling

Syfte och mål med delaktiviteten:

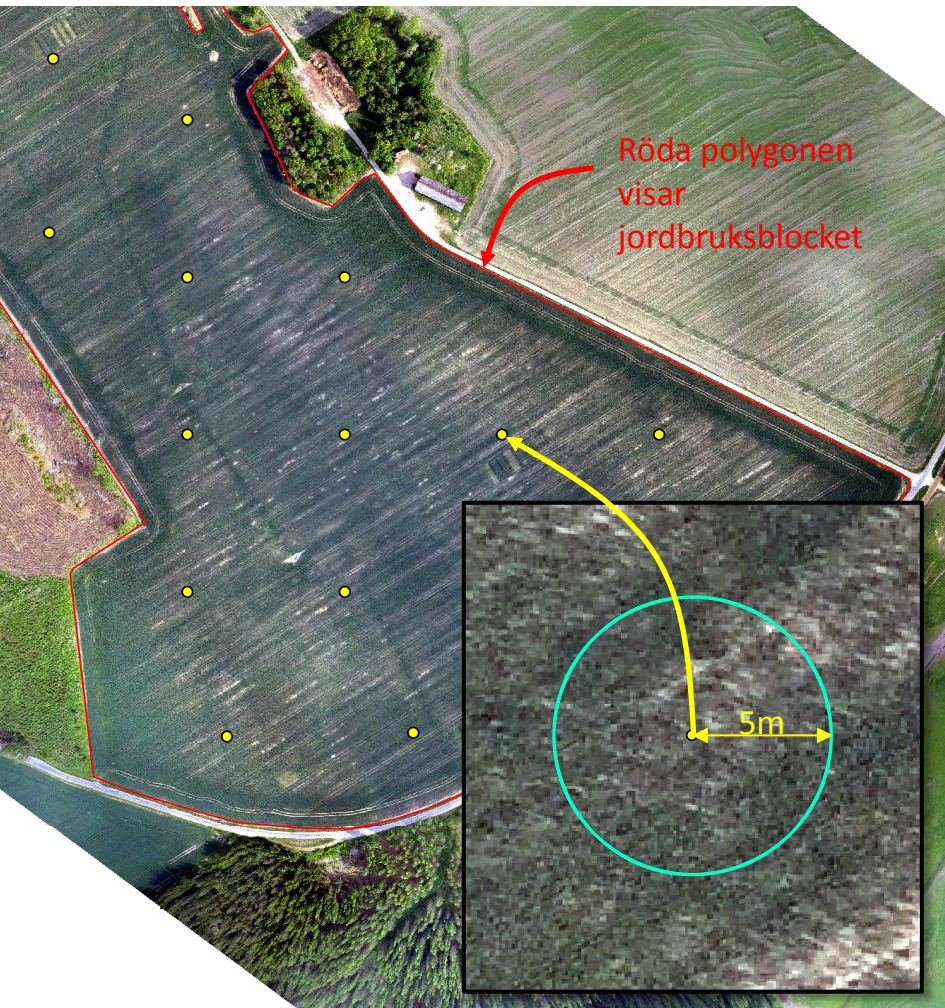
utveckla och anpassa algoritmer som översätter tillgängliga gröd- och markdata till platsanpassade åtgärdsrekommendationer.

3d. Underlag för ett webbaserat beslutsstödssystem för precisionsodling

Med hjälp av olika verktyg som handburna sensorer, drönare och satelliter:

- I **höstvete** bestämma **skörd** vid kompletteringsgödsling.
- I **höstraps** bestämma **kväveinnehåll på hösten** för optimal beräkning av vårgivan.
- I **gräsvall** bestämma **näringsinnehåll** för optimal **skördetidsprognos**.

Data från drönare:



Fotografering med RGB-kamera
(RX-100, Sony)

Fotografering med multispectral kamera
(RedEdge, Micasense)

Skapande av mosaik
(SOLVI)

Skapande av mosaik
(Micasense ATLAS)

Georeferering

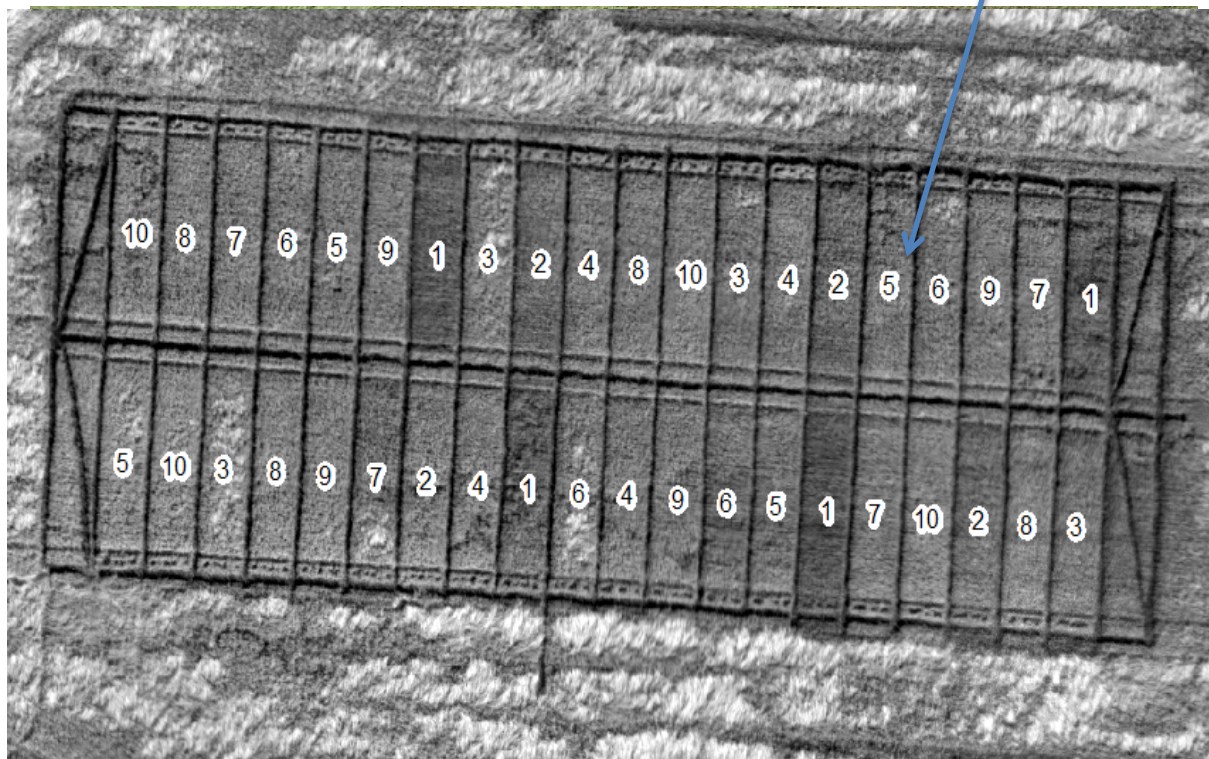
Mosaikerna georefererades med hjälp av Jordbruksverkets blockdatabas. Ofta 5-10 m fel innan georeferering. (ArcGIS, ESRI).

Dataextraktion

Ett medelvärde för alla celler inom 5 m radie från inmätta punkten beräknades Detta gjordes band (www.r-project.org).

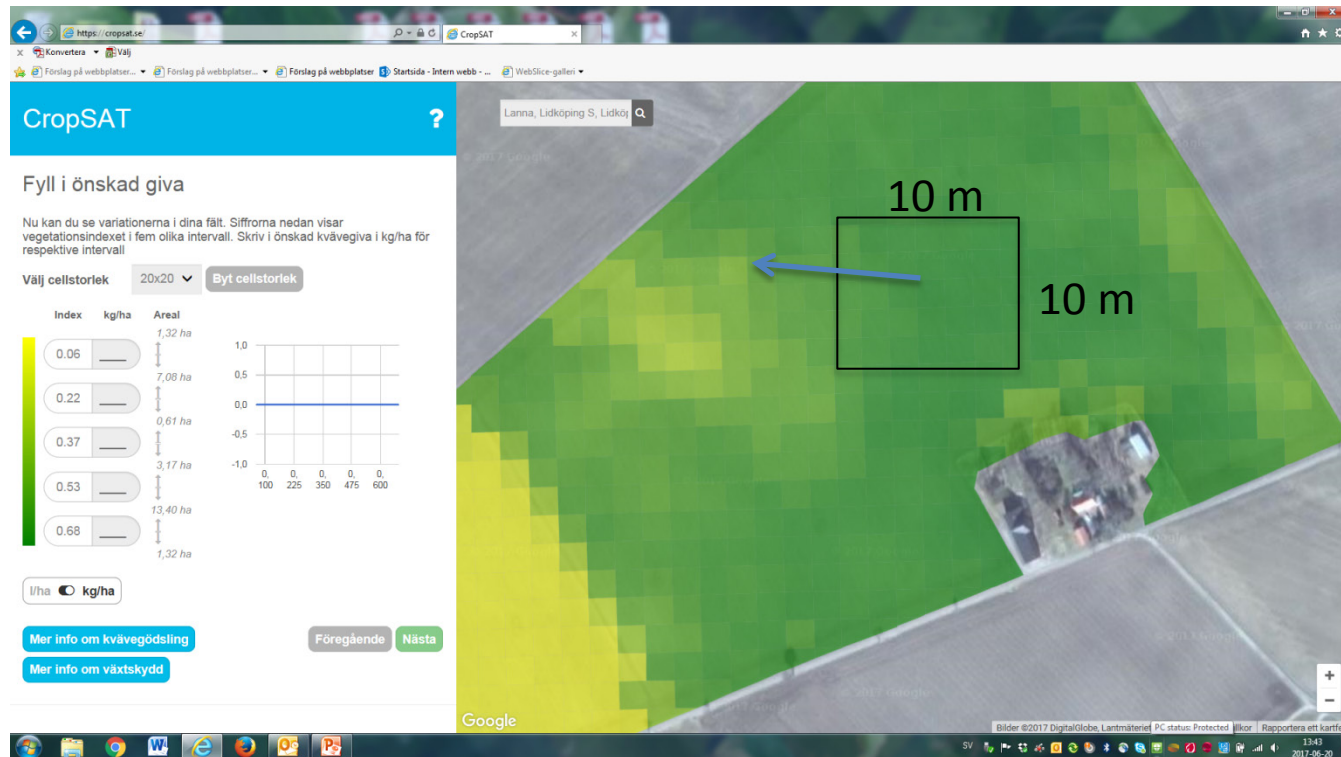
Data från drönare i försök:

Mosaikbildens pixlar 8 x 8 cm, medianvärdet i varje ruta tas fram för de fem våglängdsbanden



Data från satelliter:

- 10x10, 20x20, 30x30 m raster/pixel = 1 värde



Winter oilseed rape

Decision support for calculating the optimal N rate in spring to winter oilseed rape by estimation of N-uptake in autumn by means of remote sensing.

Four fields, crop sampling (1 m²) at five positions in each field in late autumn, n= 25.

RGB-image 13/10 2016, Entorp, Skara, 22 – 144 kg N/ha



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Winter oilseed rape

Lanna, skifte 13, 12 – 84 kg N/ha

Arkiv Redigera Visa Historik Bokmärken Verktyg Hjälp

Atlas — MicaSense Farm Map — MicaSense Solvi

solvi.nu/projects/122

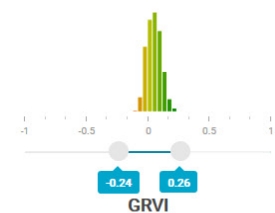
← 161013Lanna_skifte13

ORTHOPHOTO ANALYSIS & PRESCRIPTION EXPORT

ANALYSIS



SELECT VEGETATION INDEX



PRESCRIPTION

COMING SOON

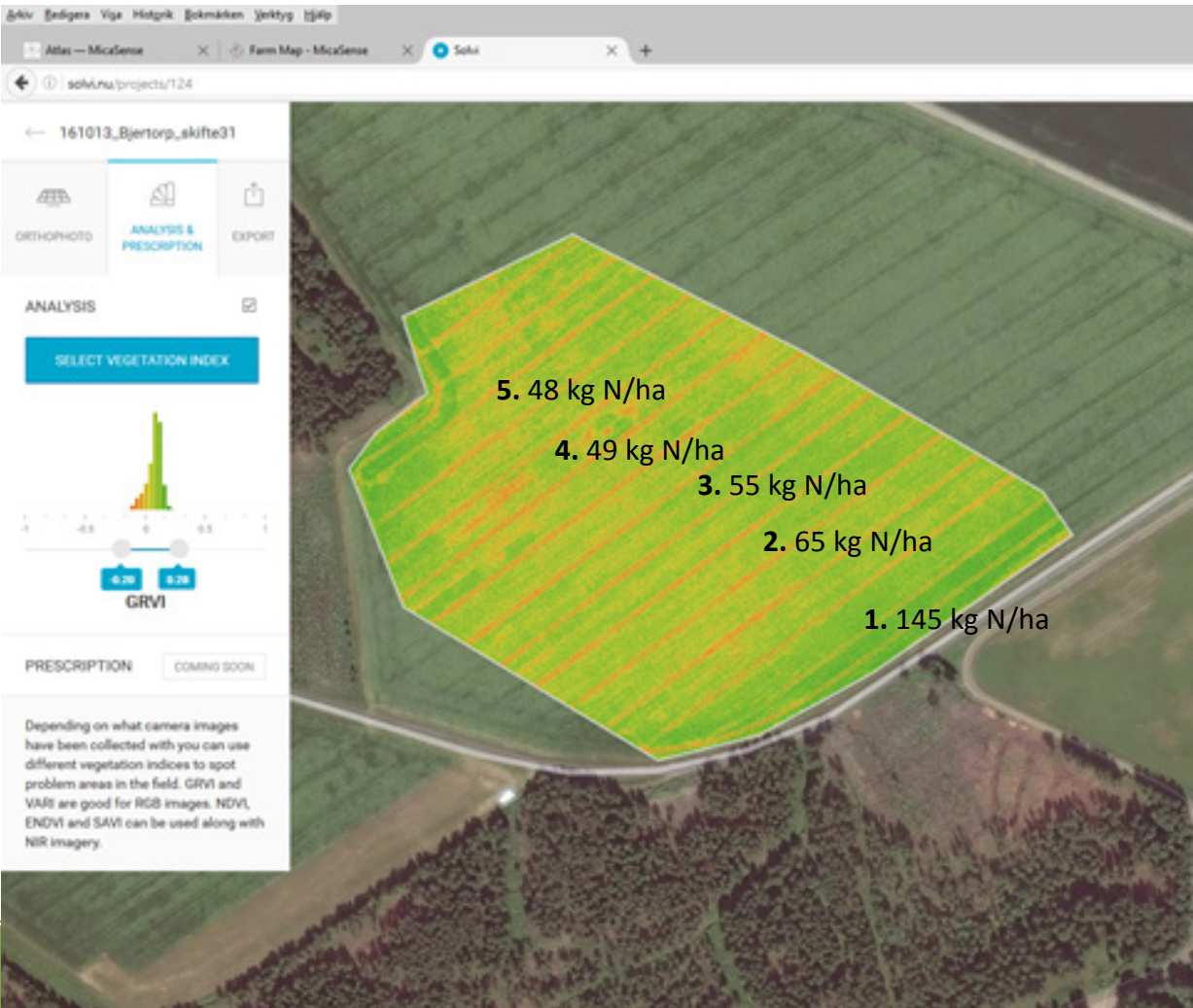
Depending on what camera images have been collected with you can use different vegetation indices to spot problem areas in the field. GRVI and VARI are good for RGB images. NDVI, ENDVI and SAVI can be used along with NIR imagery.



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Winter oilseed rape

Bjertorp skifte 31, 48 – 145 kg N/ha



Results 2016:

Modelling the autumn N-uptake of winter oilseed

- Best prediction of N-uptake (11-90 kg N/ha, 4 sites, n= 20) with **RGB-pictures** (drone) and handheld **GreenSeeker** (NDVI), RMSECV = **12 kg N/ha**.
- Good prediction models also with **all wavebands** (RMSEC = 14 kg N/ha) or single indices, RMSECV = **15-16 kg N/ha** (drone).
- No good prediction with satellite-pictures since sampling area (1 m²) did not properly represent the area of 10 - 30 m pixels in the satellites.

Regression models (PLS and SLR)

Response:

N-uptake (kg N/ha).

Predictors:

All wave bands (B, G, R, Rededge, NIR)

Indices (NDVI, MSAVI, SAVI)

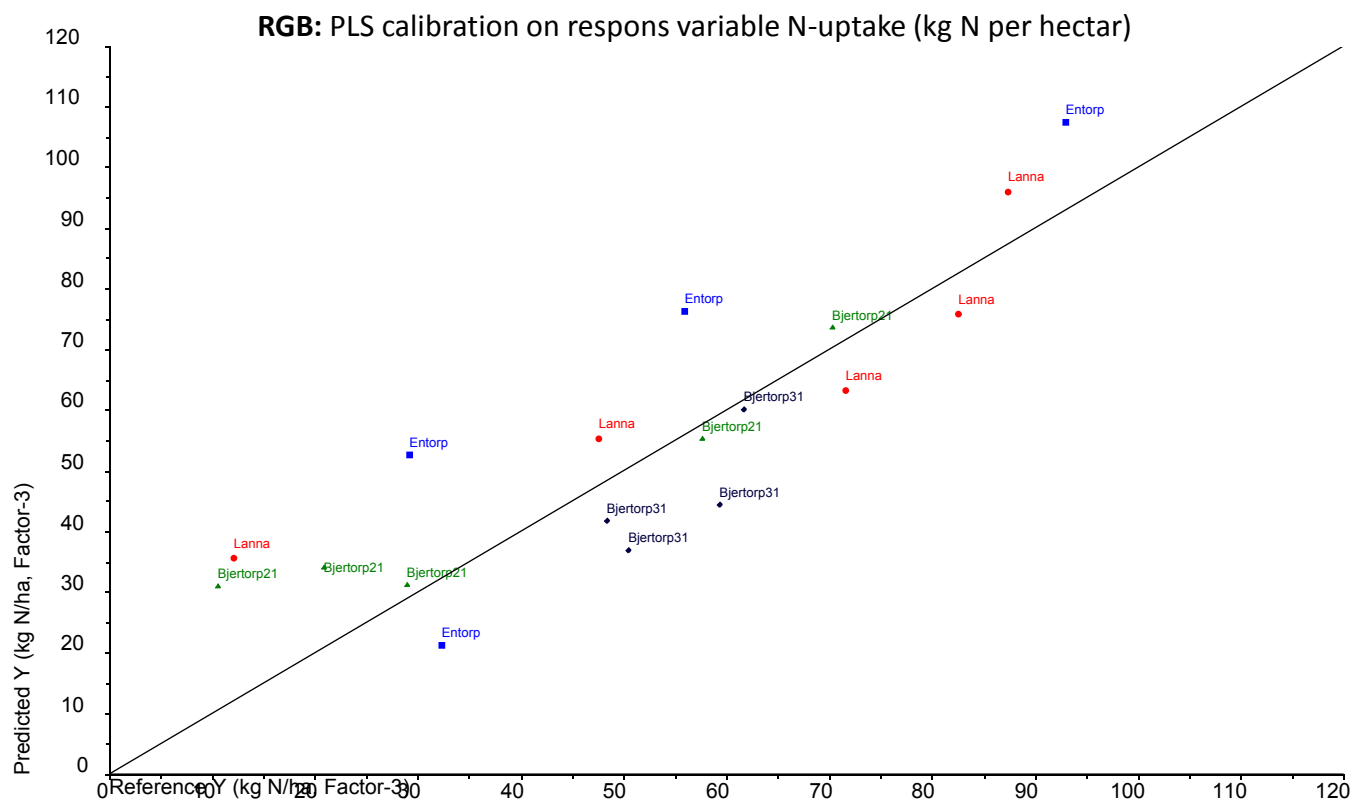
RGB

Regression models		Cross-validated		
		r ²	RMSECV	rpD
UAV- Micasense, indices				
NDVI	all	0,38	33	1,2
	not 2 high	0,64	15	1,6
	val. gårdar	0,58	16	1,5
MSAVI2	all	0,37	33	1,2
	not 2 high	0,61	16	1,5
	val. fields	0,52	17	1,4
SAVI	all	0,38	33	1,2
	not 2 high	0,64	15	1,6
	val. fields	0,58	16	1,6
UAV - Micasense, wavebands (B, G, R, Red edge, NIR)				
not Entorp	all	0,24	37	1,0
	ej 2 höga	0,69	14	1,7
	val. fields	0,30	21	1,1
UAV – Sony (R, G, B)				
	all	0,16	38	1,1
	not 2 high	0,77	12	2,1
	val. fields	0,71	13	1,9
Handheld GreenSeeker				
NDVI	all	0,57	28	1,5
	Not 2 high	0,78	12	2,1
	val. fields	0,68	14	1,8

Results:

UAV - Sony (R,G, B)

Cross validated model (4 sites), $R^2 = 0,71$, RMSECV = 13)



Plans for 2017:

- 50-70 crop samples at 4-6 sites 2017
- 10-20 samples with high biomass, 100-200 kg N/ha.
- Improve georeferencing by using 2- 3 markers around each sampling plot, instead of only one (2016).
- Adapt sampling strategi for satellite pictures.
Sample in larger homogenous areas!

Results 2016:

Modelling yield in winter wheat

- **Using 6 fields with 20 samples in each (n= 120):**
No good prediction of yield (or N-uptake and biomass) was achieved with the models tested (multispectral images from drones and satellites).
- No good prediction due to sampling area (0,5 x 0,5 m) did not properly represent the area from the satellite and UAV pictures.
- **Using 4 field trials from 2015 (n= 225) and a handheld sensor (multispectral):**
Good prediction of yield was achieved with all wavebands, NDVI+Rededge and MSAVI+Rededge.

n= 225	Korsvalidering			Validering gårdsvis		
	r2	rmse cv	rpd valid.	r2	rmse cv	rpd valid.
Alla våglängder	0,82	895	2,3	0,73	1326	1,6
utan ON	0,45	797	1,4			
Index						
NDVI	0,66	1219	1,7			
MSAVI	1,45	1549	1,4			
SAVI	0,34	1694	1,2			
Rededge (NDRE)	0,73	1078	1,9			
Clor.index	0,72	1098	1,9			
Rededge+Cl.index	0,75	1043	2,0			
NDVI+Rededge	0,76	1032	2,0	0,68	1187	1,8
MSAVI+Rededge	0,75	1050	2,0	0,59	1374	1,5

Regression models (PLS and SLR)

Response:

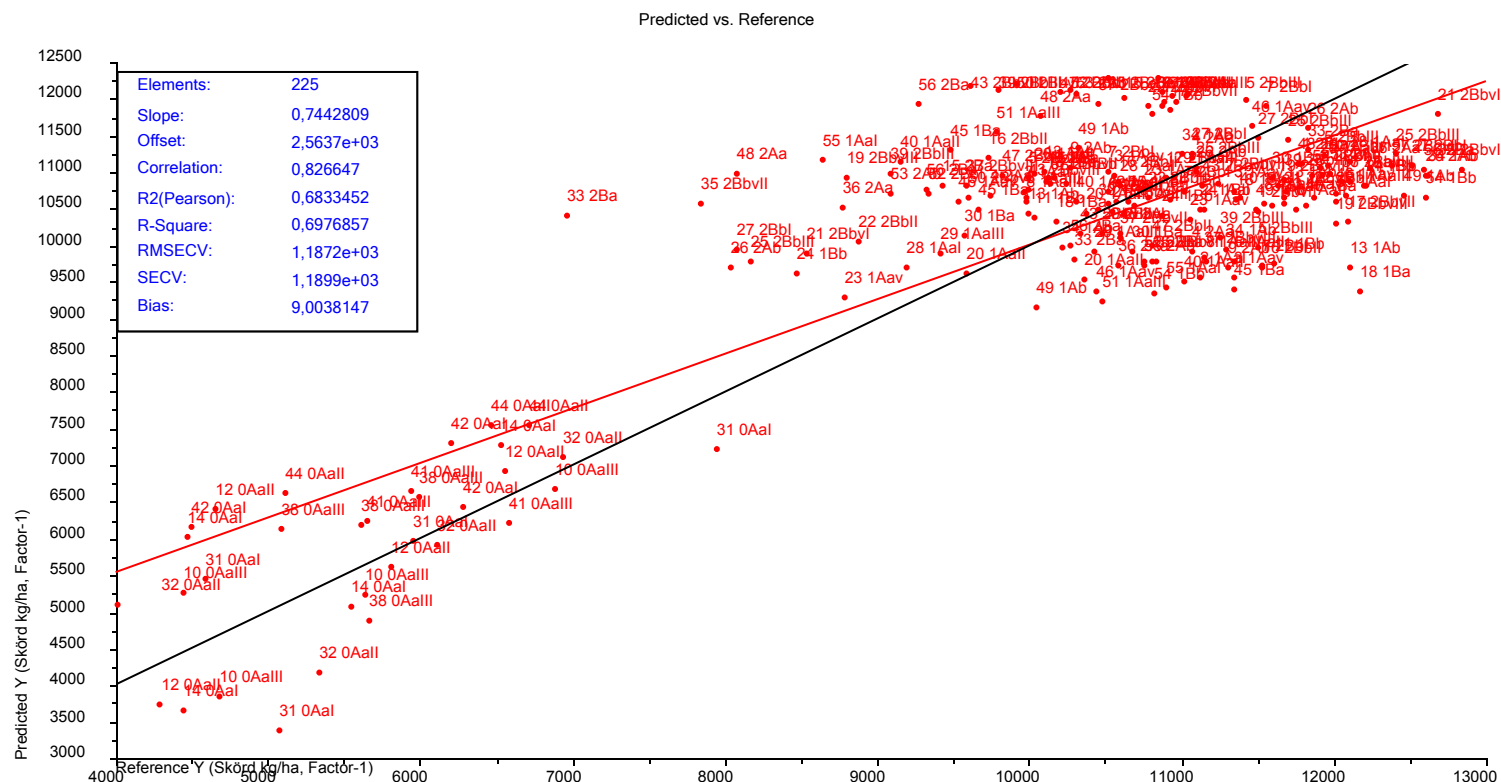
Yield (kg/ha)

Predictors:

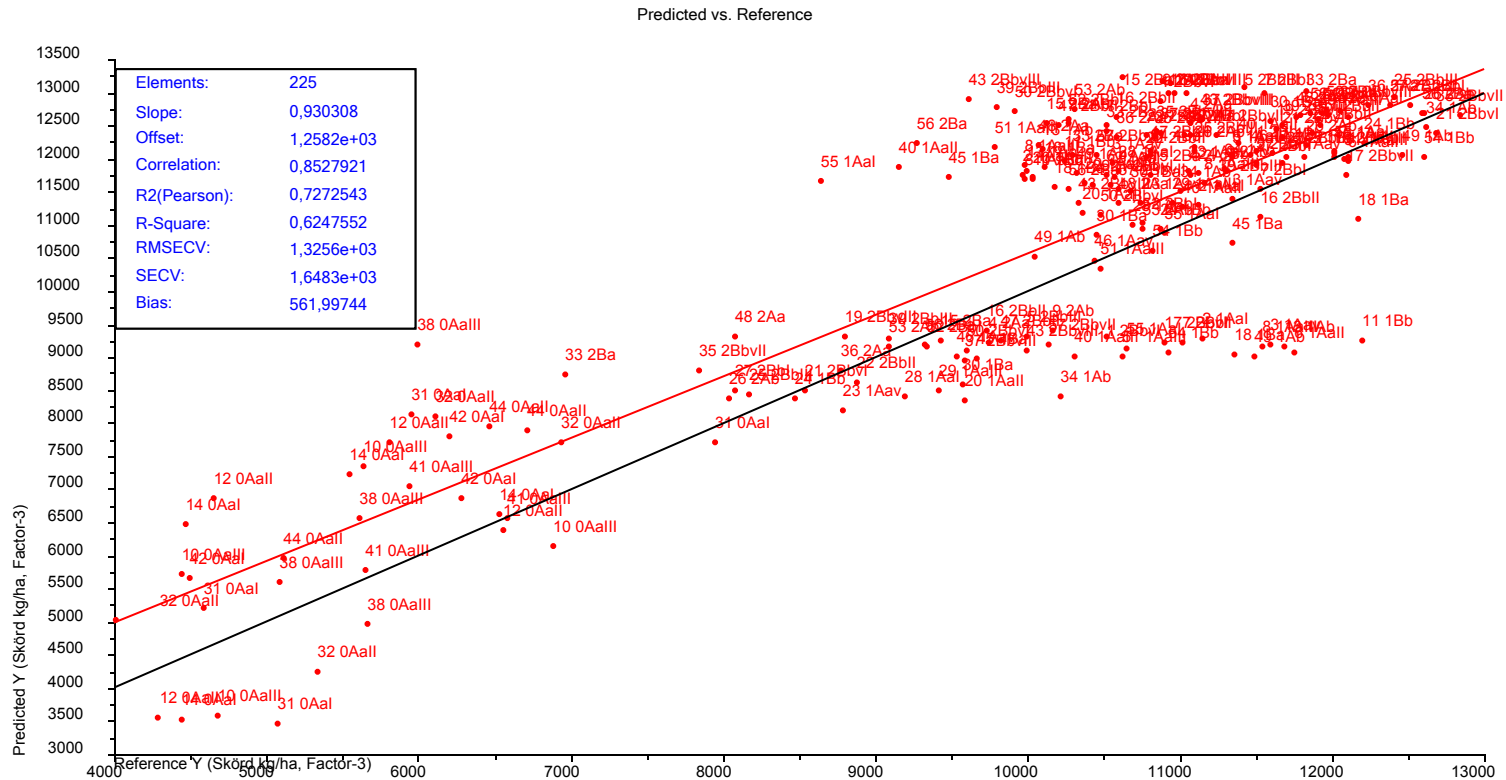
All wave bands (400-1000)

Indices (NDVI, MSAVI, SAVI

NDVI+Rededge, cross validation with sites (4)



All wave bands, cross validation with sites (4)



Results 2017:

Modelling yield in winter winter wheat

- Using 2 field trials, Bjertorp (n= 40) and Skofteby (n= 64), and a multispectral sensor equipped drone

Bjertorp: good prediction of yield was achieved with all wavebands, RGB, the indices ChII and NDRE.

Skofteby: good prediction of yield was achieved with all wavebands

Regression models (PLS and SLR)

Response:

Yield (kg/ha)

Predictors:

5 wave bands (B,G,R, Rededge, NIR)

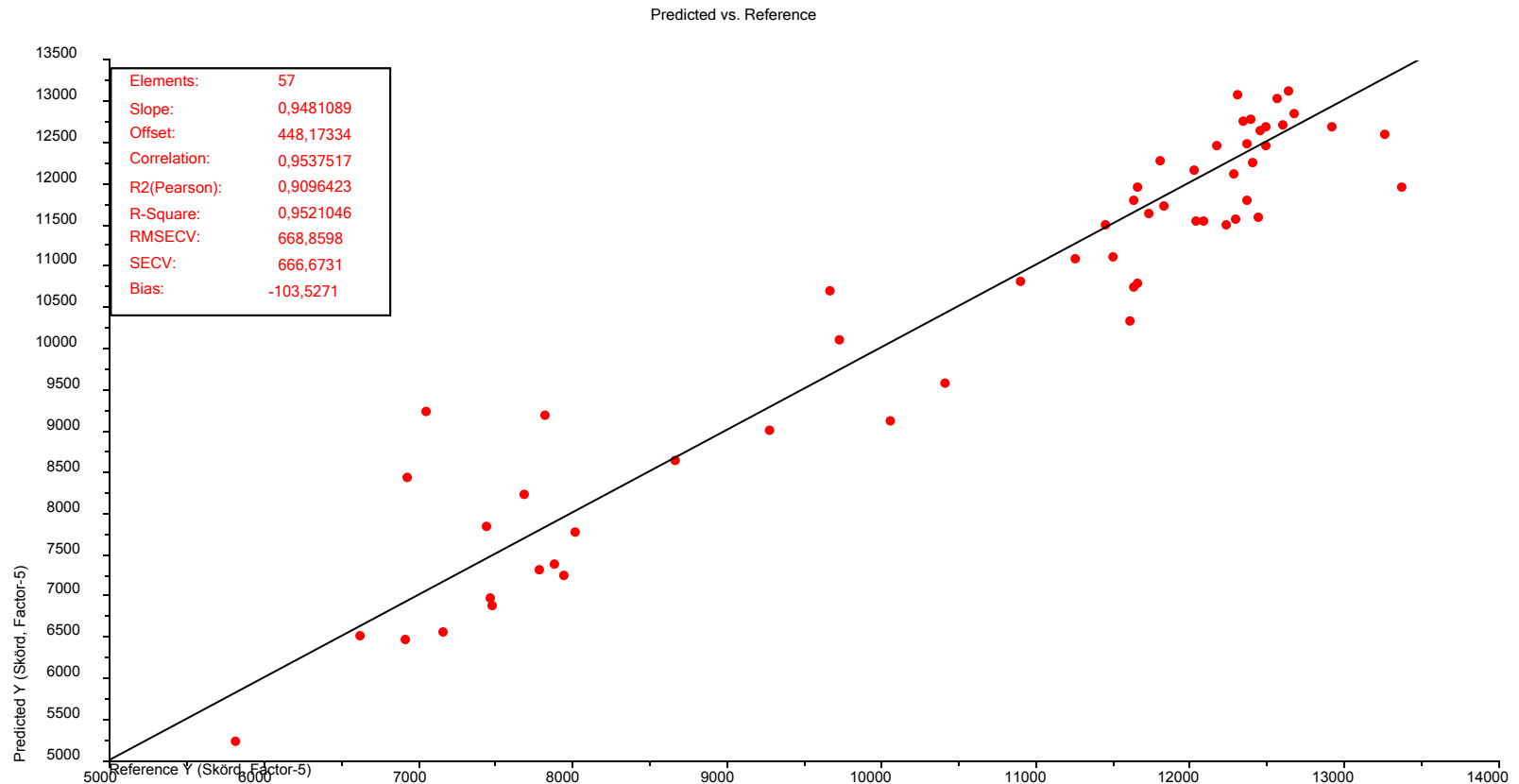
Indices (NDVI, ChII, NDRE, MSAVI 2)

	Cross validation of N-treatments		
Bjertorp 2017	r2	rmsecv	rp
Wave bands (5)	0,91	668	3,3
RGB	0,84	897	2,4
NIR	0,41	1681	1,3
Rededge	No correlation!		
Indices:			
NDVI	0,51	1532	1,4
ChII	0,80	972	2,2
NDRE	0,76	1064	2,0
MSAVI2	0,63	1333	1,6

	Cross validation of N-treatments		
Skofteby 2017	r2	rmsecv	rp
Wave bands (5)	0,92	601	3,6
Without ON	0,80	553	3,9
RGB	No correlation!		
NIR	0,7	1172	1,9
Indices			
NDVI	0,69	1339	1,6
ChII	0,26	2058	1,1
MSAVI2	No correlation!		
Prediction of Bjertorp:			
Model: Skofteby			
Wave bands (5)	0,79	1302	1,7

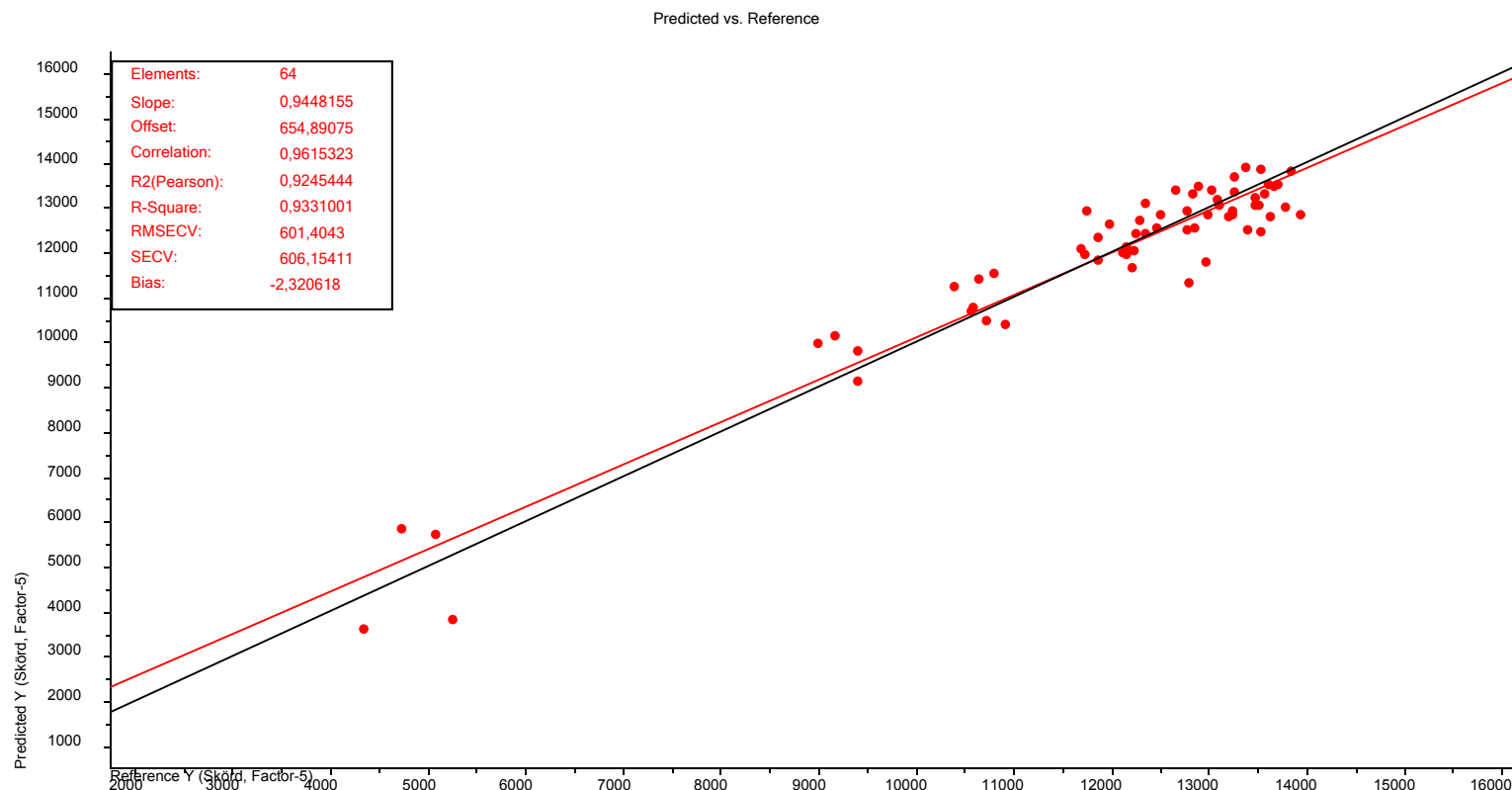
Bjertorp 2017

All wave bands and cross validation with N-treatments (3)



Skofteby 2017

All wave bands and cross validation with N-treatments (16)

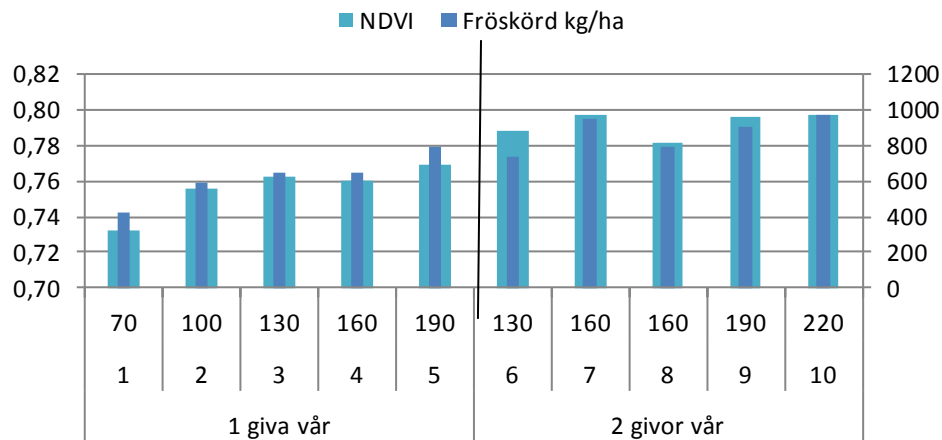


Results 2016:

Modelling protein, energy and NDF in timothy grass leys

- No good regression models could be made when using UAV-pictures from 3 fields with 5 samples in each at 3 harvest dates, n= 45 or a field experiment (n= 70). Satellite pictures not analyzed yet.
- Visual differences between treatments in field trials were well described by e.g. NDVI 8/7 2016 (UAV) and IR/R och Si1 15/6 2017 (handheld N-sensor)!

NDVI, timotej-försök 2016



Index: IR/G, timotejförsök 2017



Results 2017:

Modelling protein, energy and NDF in timothy grass leys

- Using a field trial in a timothy grassley with increasing N-rates ($n=40$) and crop sampling at three harvest dates (15/6, 27/6, 10/7, $n=120$).
- Good prediction of yield was achieved with all wavebands, RGB, the indices GNDVI and ChII (two dates $n=80$)
- The results from the third harvest date have not yet been analysed.

Regression models (PLS and SLR)

Response:

Yield (kg/ha)

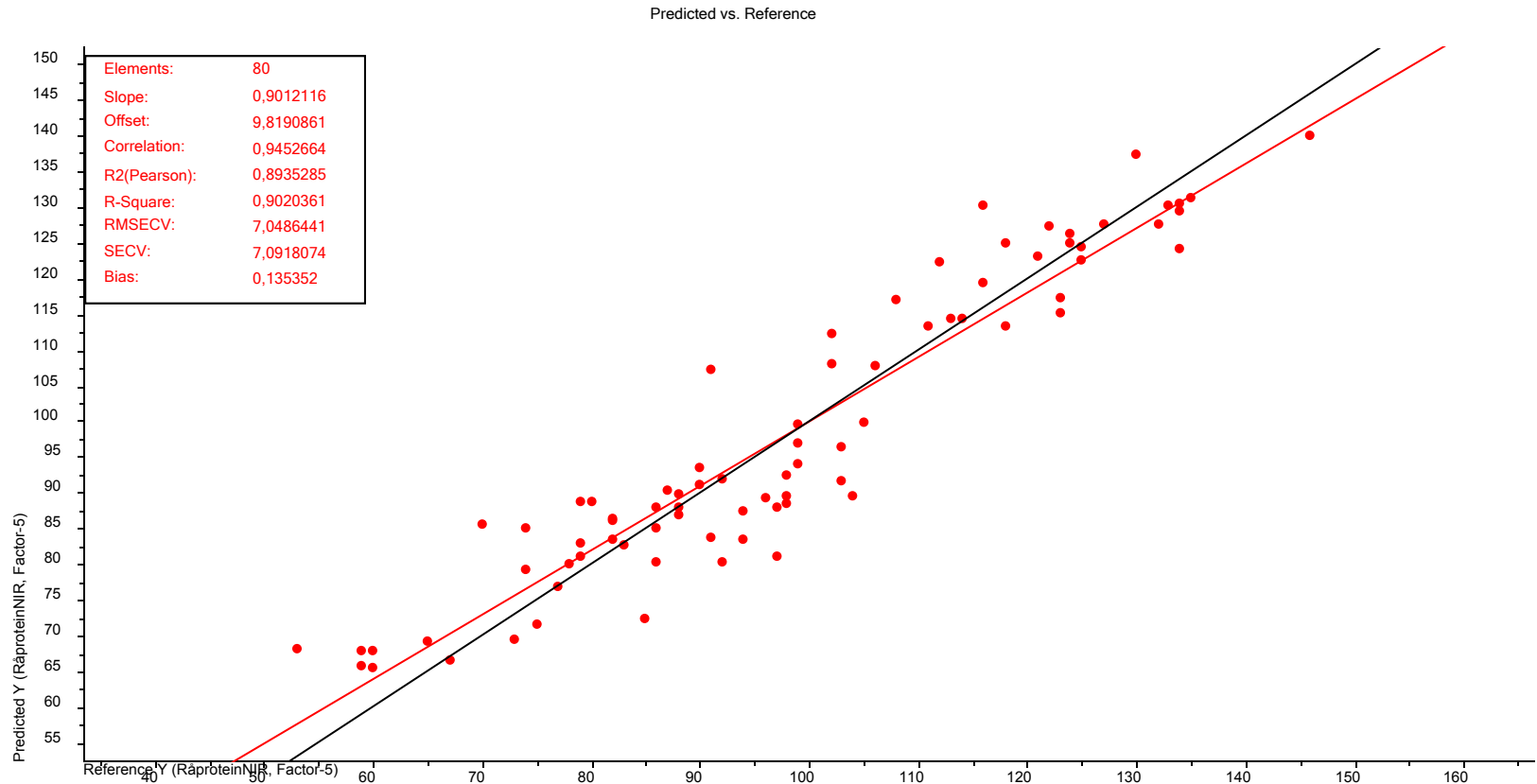
Predictors:

5 wave bands (B,G,R, Rededge, NIR)

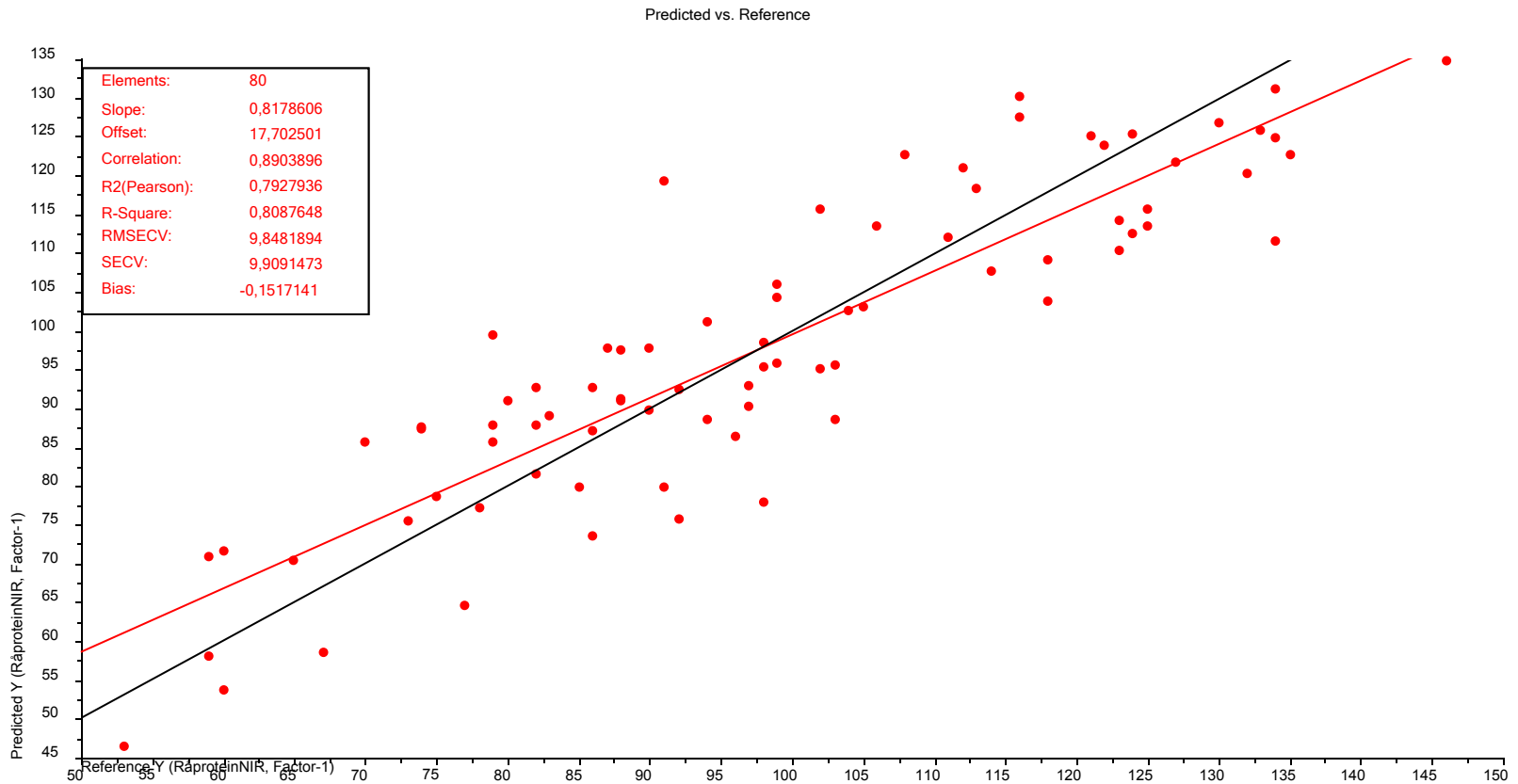
Indices (GNDVI, ChII)

Two harvest - dates, $n=80$	Crossvalidation (N-treatments)		
	r ²	RMSECV	RPD
Protein:			
Wavebands (5)	0,89	7,0	3,1
RGB	0,88	7,3	3,0
NIR	0,74	11,1	1,9
Indices:			
GNDVI	0,79	9,85	2,2
ChII	0,79	9,85	2,2

All wavwbands and crossvalidation of N-treatments (10)



GNDVI and cross validation with N-treatments (10)



Projektets finansiärer

Förutom Interreg Öresund-Kattegat-Skagerrak har projektet även följande finansiärer:

