

Field phenotyping at NMBU and progress in predicting grain yield from multispectral UAV images

#### Morten Lillemo



#### NPPN Båstad, 22 November 2019

## Environmental control vs relevance to field conditions





TRENDS in Plant Science

### Control of field environments

- Mist irrigation for control of humidity (promotion of plant diseases):
- Vollebekk field station, NMBU
- Fusarium head blight
- Leaf blotch diseases
- Pre-harvest sprouting

### Control of field environments



• Evaluation of waterlogging tolerance:



### Control of field environments



• Polytunnels for controlling rain (and temperature):



### NMBU strategic alliance



 Faculty of Biosciences



• Faculty of Mathematical Sciences and Technology



# Multispectral imaging



#### Micasense RedEdge



Matrix 100





#### Industrial innovation project: Virtual phenomics



May 2017 – April 2022, Budget: 10.1 mill. NOK (≈1.1 mill EUR)



#### **Genomic selection**





### Prediction of grain yield





Postdoc Sahameh Shafiee

- Yield trial with 300 wheat breeding lines x 2 rep
- 3 dates with multispectral images

Feature	Definition	
Blue	475 nm	
Green	560 nm	
Red	668 nm	
RedEdge	717 nm	
NIR	840 nm	
NDVI	(NIR-RED)/(NIR+RED)	
MTCI	(NIR-REG)/(REG-RED)	
EVI	2.5 (NIR – RED)/(NIR +6 RED – 7.5 BLUE +1)	



#### **Feature selection**





#### Mean Absolute Error changes with the number of features Graminor-2018

### Grain yield prediction



Support vector regression



## Improved genomic prediction models

- Preliminary results based on yield trials with 300 spring wheat lines.
- Prediction accuracy of grain yield (correlation coefficients predicted vs observed):



Year	Only spectral bands	Only markers	Spectral bands + markers
2017	0.737	0.800	0.865
2018	0.658	0.781	0.822

# Genetic and physiological basis of grain yield





PhD student Tomasz Mróz

# Yield increase apparent under high and low N (and drought)





# Modern cultivars have more grains per spike



U

### Phenotyping with robot







### Imaging with RGB and 360 cameras





RGB camera (17.07.2019)



 $\rightarrow$  Use for counting heads/m<sup>2</sup>

→ Detection of plant diseases inside the canopy

360 camera (17.07.2019)

# Plant breeding and virtual reality









Plant phenotyping NMBU

MAKING VIEW

## Bringing the field to the breeder





#### VR prototype workshop February 2019

## Bringing the field to the breeder





### vPheno project group

<u>NMBU – Biovit</u> Morten Lillemo Sahameh Shafiee Tomasz Mróz

<u>NMBU – RealTek</u> Ingunn Burud Pål Johan From Lars Martin Lid <u>Graminor</u> Muath Alsheikh Jon Arne Dieseth Nikolai Ødegaard

Making View Are S. Vindfallet Daniel Ervik Håkon Kleppe Normann <u>Boston University</u> Osama Alshaykh

<u>CIMMYT</u> Jose Crossa Matthew Reynolds





Norwegian University of Life Sciences









#### **High throughput field phenotyping** NOVA PhD course of 5 ECTS 22-26 June 2020, in Ås, Norway



### Registration will open soon!



A full week of practical, hands-on training

- Hand-held sensors
- Drone phenotyping
- Robot phenotyping
- Image analysis and trait prediction

Further info: <u>www.nmbu.no/nova</u> or morten.lillemo@nmbu.no





http://www.clipartkid.com/