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Decision support tools for spring N fertilisation of winter oilseed rape

- estimation of N uptake in late autumn using UAV and satellites

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The message

- An N application model was implemented in the freely available decision support system ”Cropsat.se”.
- In **Cropsat**, N uptake in late autumn can be calculated from satellite images and variable rate application files can be made for spring N fertilisation.

Introduction

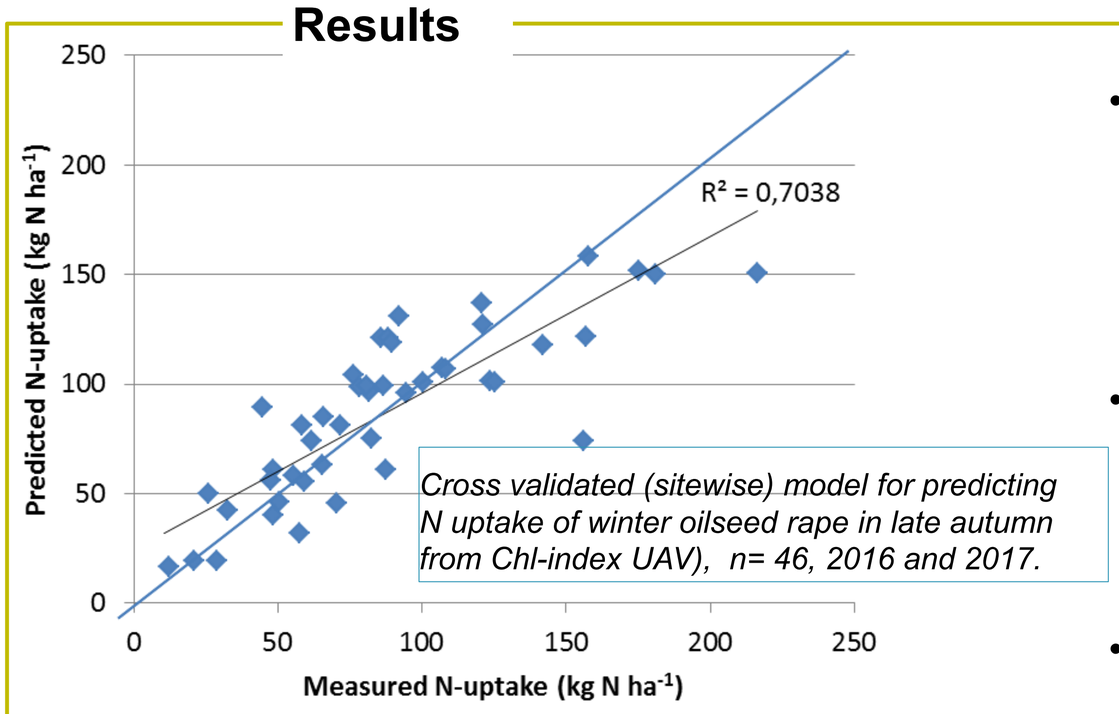
- In this study (2016-2017) we investigated how to use mosaic images from unmanned aerial vehicle (UAV) or satellite imagery as inputs for tools determining nitrogen (N) uptake in late autumn and to capture within field variations.
- To calculate the optimal spring N fertilisation rate to winter oil seed rape (*Brassica napus* L.), Swedish farmers are recommended to determine the crop N uptake in late autumn. This is normally done by the “fresh weight method” (kg fresh weight per m^2 × 56) or by scanning the crop with a sensor-equipped tractor.

Methods

- Seven fields in Southwest Sweden with winter oilseed rape were scanned 13th October 2016 and 2nd november 2017 with an **UAV (Pitchup Explorian 8**) equipped with the **5-band Micasense Rededge sensor (**blue, green, red, red edge, NIR) **Satellite images (Sentinel, 10 wavebands**) from 6th November 2017 were used.
- In each field, crop was cut in 1 m^2 plots at five positions 2016 (three fields, n = 15) and 10 positions 2017 (four fields, n= 40)
- The UAV-sensor images were georeferenced and stitched. Prediction models (univariate regression and partial least squared regression; PLS) were calibrated and cross-validated. Wavebands and indices were used as predictors.

Variation in N-uptake within a winter oilseed rape field, RGB-image 13 Oct 2016, Lanna, Sweden.

Results



Cross validated (sitewise) model for predicting N uptake of winter oilseed rape in late autumn from Chl-index UAV), n= 46, 2016 and 2017.

- **The N-uptake** varied between **11 and 216 kg N ha^{-1}**. The best prediction of N-uptake was made from models based on all wavebands or a Chl-index from the 5-band UAV sensor. Root Mean Squared Error of Cross Validation (RMSECV) was **25 kg N ha^{-1}** and the coefficient of determination (r^2) 0.70 for both models.
- When the dataset was limited to include a maximum N uptake of **150 kg N ha^{-1}** RMSECV was reduced to **18 and 17 kg N ha^{-1}** for all wavebands and Chl-index respectively. If the dataset was limited to a maximum N uptake of **100 kg N ha^{-1}**, RMSECV was reduced further to **13 kg N ha^{-1}** for both models.
- Using satellite sensor-data, N-uptake was best predicted by the index MSAVI.

Conclusions

- It was possible to determine within-field variations in N uptake of winter oilseed rape in late autumn with a sensor mounted UAV or satellite.
- The best models were based on all wavebands or the index Chl (UAV) and the index MSAVI (satellite) RMSECV could be improved if limiting the N uptake to 150 or 100 kg N ha^{-1} in the models.

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