REMOTE NIR-SENSOR FUSION WITH WEATHER DATA FOR IMPROVED PREDICTION OF WHEAT YIELD MODELS

S.I. Øvergaard and A. Korsaeth

Arable Crops Division
The Norwegian Institute for Agricultural and Environmental Research
Kapp, Norway

T. Isaksson

Departmen of Chemistry, Biotechnology and Food Science
The Norwegian University of Life Sciences
Ås, Norway

ABSTRACT

Grain yields were predicted several weeks ahead of harvest on the basis of VIS-NIR reflectance spectroscopy data and weather data from four years (2007-2010) and three sites. The regression models based on VIS-NIR data alone had severe bias between years. This bias was significantly reduced when weather data were included in the model.

Keywords: Bias, Data fusion, NIR, PLS, CPPLS

INTRODUCTION

Robust yield prognoses enable for the production of yield maps, which can be used for planning the next season, identifying problem areas and for decision support. Yield prediction models must cope with year-to-year variation, which may be considerable. Models based on VIS-NIR spectroscopy data are commonly used for yield prediction, but such models are often reported to lack sufficient robustness when covering more years (Prasad et al. 2007). In this study, the objective was to use weather data to improve VIS-NIR based yield prediction models by means of data fusion.

MATERIALS AND METHODS

Three field trials were established in the years 2007 to 2010. Each trial comprised 144-160 plots of spring wheat (*Triticum Aestivum var. L*). There were seven site-years of data, comprising altogether 976 plots, which were analyzed gravimetrically for grain yield and moisture. VIS-NIR spectra were collected with a FieldSpec3 spectroradiometer at five Zadoks (Z) development stages each season (Z31, Z59, Z65, Z87 and Z90). Only data from Z65 is utilized here. Weather data was extracted from the Norwegian national yield prognosis

programme, and comprised aggregated temperature, precipitation, windspeed, radiation, humidity and potential evapotranspiration. All six variables were evaluated in four phenological phases each season (altogether 24 variables). Regression models were computed with a recent extension of Partial Least Squares (PLS), Canonical Partial Least Squares (CPPLS, Indahl et al. 2009). Models were computed with a leave-year-out cross-validation strategy.

RESULTS AND DISCUSSION

The explained variance of all models were high (R^2 from 0.76 to 0.94). By combining VIS-NIR data with weather data, model RMSEP and bias were significantly reduced, except in 2008, when the uncorrected model already fitted the measured data well (Fig.1). This study show the potential of improving NIR spectra based prediction models by including season-specific information, such as weather data, which becomes more available through improvements in internet based meteorological services.

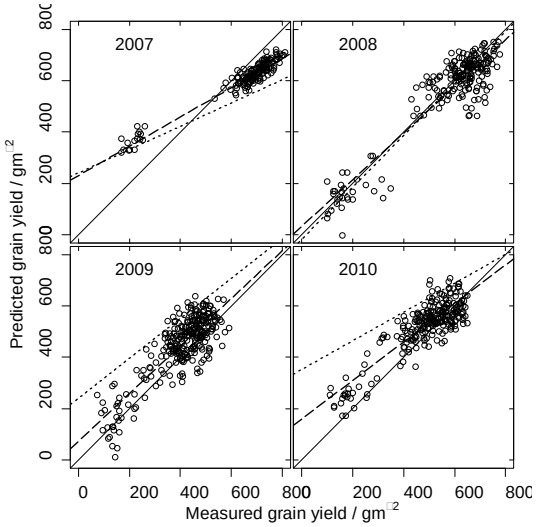

Figure 1. Predicted grain yield from CPPLS plotted against gravimetrically measured grain yield in a leave-year-out cross-validation. Regression lines from VIS-NIR only (dotted line) and fusion of VIS-NIR and weather data (dashed line) drawn in each subplot.

CONCLUSION

Fusion of VIS-NIR spectroscopy and weather data by means of CPPLS regression clearly outperformed the models based only on VIS-NIR data.

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