Indices of crop water stress from UAV images precisely map residual nitrogen and risk of nitrate leaching spatial variability

Jan Haberle[1], Kateřina Křížová[2] , Pavel Svoboda[1], Gabriela Kurešová[1], Jan Lukáš[2] and Ivana Raimanová[1]

[1] Division of Crop Management System, Crop Research Institute, Prague, Czech Republic
[2] Division of Crop Protection and Plant Health, Crop Research Institute, Prague, Czech Republic

E-mail: haberle@vurv.cz

Abstract

The risk of nutrient losses in production of vegetables and early potatoes under irrigation is increased by significant spatial variability of soil water capacity and infiltration rate of fields. The impact of water stress on not irrigated crops, occasionally grown on the vegetable fields, was proved to precisely map the soil conditions in a scale of less than one meter. Nitrogen balance, the amount of N not exported in yield was tightly related to soil conditions and the stress indices derived from airborne images data (r = 0.80-0.90).

Keywords: soil texture, soil water capacity, thermal and RGB images, root depth

1. Introduction

Vegetable production, including early potatoes, is known for low nitrogen utilization efficiency and higher residual mineral N left after harvest (Haberle et al. 2018). The risk of N nitrate leaching is increased by irrigation and high soil spatial variability of fields situated often near rivers. In the Czech Republic these regions are also utilized for the accumulation and extraction of drinking water (Bruthans et al. 2018).

In the study the impact of water stress on not irrigated crops, occasionally included to vegetable crop rotations was used. Previously, we showed that soil texture and calculated water capacity variability had a tight relationship with water stress impacts (including ^{13}C discrimination) on the crops grown in the fields (Haberle et al. 2018)

2. Methods and Materials

Soil mineral N to depth of 90 cm, nitrogen uptake and export in wheat grain yield in four vegetable fields along lower Jizera river were determined in grid of sampling points in previous years. The data were related to indices of crop growth and impact of water shortage monitored with the use of digital RGB and thermal images from drones. Soil texture, water capacity, infiltration and root growth in selected points were used for estimation of nitrate leaching risk.

3. Results

Wheat nitrogen balance, the amount of N from fertilizers not depleted and exported in yield was tightly related to soil conditions and the field stress indices of the crops and from images data (r = 0.80-0.90). On the basis of the relationships the risk of leaching of residual nitrogen may be mapped in scale of one meter and less.

4. Conclusions

Maps of risk of higher residual N and nitrate leaching may serve for spatially variable irrigation and fertilization, yet not used in vegetable production.

Acknowledgements

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References

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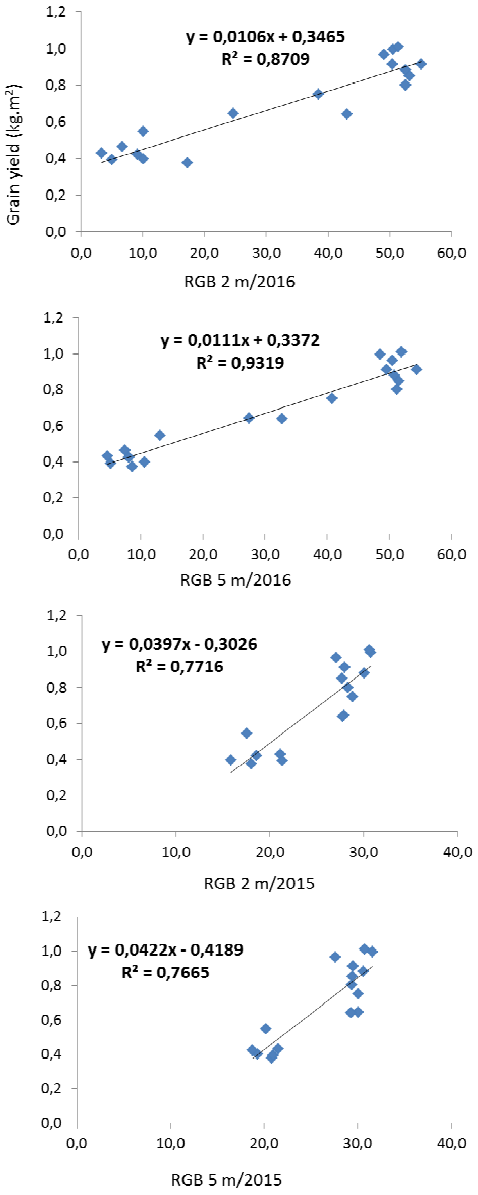

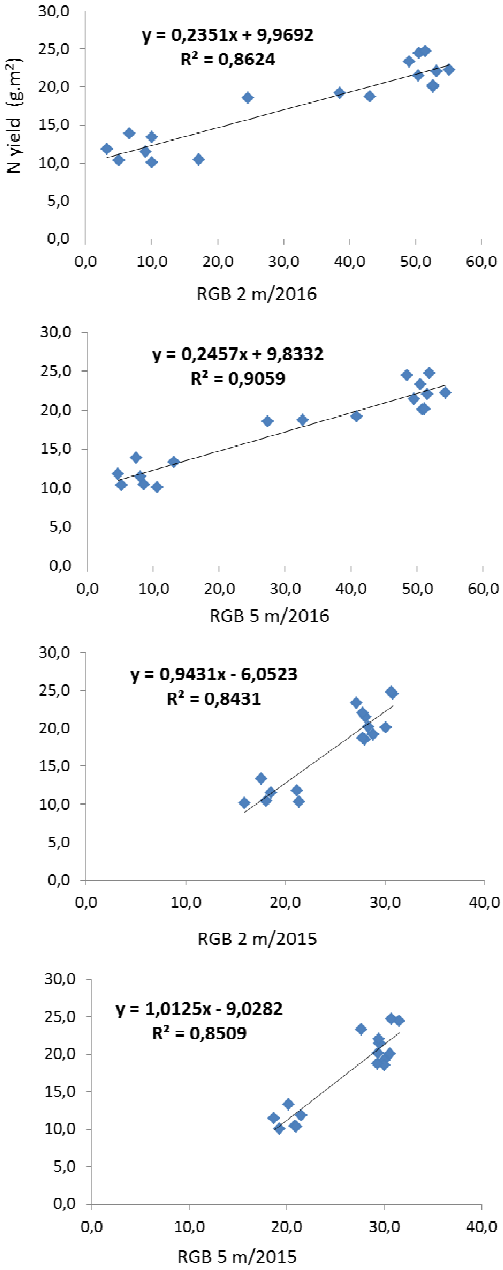

Figure 1 The example of reltionships of not irrigated wheat grain yield (left) and N exported in grain yield (above) in 2019 and indices derived from RGB digital images of stressed crop in 2015 and 2016 in 2 m and 5 m buffer zone around sampling points.