Comparison of plant and soil mapping in *Prunus domestica* L. orchard

Jana Käthner, Werner B. Herppich, Jörn Selbeck, Manuela Zude-Sasse

Leibniz Institute for Agricultural Engineering Potsdam-Bornim e.V. (ATB), Department of Horticultural Engineering, Potsdam, Germany

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Abstract. *In the present study, the soil apparent electrical conductivity, ECa, and the plant water status were analyzed in plum production (Prunus domestica L 'Tophit plus'/Wavit) targeting (i) the spatial characterization of soil ECa and fruit yield, (ii) instantaneous water status, and (iii) cumulative pattern of water status and yield.*

The plum orchard is located in semi-humid, temperate climate (Potsdam, Germany), capturing 0.37 ha with 156 trees. Measurements were carried out on each tree; this includes soil ECa, laser scanning, crop load, leaf water potential, thermal imaging of crop analyzing the crop water index (CWSI), and fruit quality. Statistical analyses were carried out for delineating hot-spots using the statistical package for MATLAB® (R2010B, MathWorks, U.S.).

In our study, spatial pattern of ECa were correlated with instantaneous CWSI as well as yield and fruit quality. Analysis of the spatial variability of CWSI and leaf area ratio showed higher correlation coefficients and enhanced significance level compared to soil data.

Keywords. *Crop load, CWSI, Hot-spot analysis, Laser scanner, Plum, Precision horticulture*

Introduction

Precision fruticulture addresses site or tree adapted crop management. In the present study, the soil apparent electrical conductivity, ECa, and the plant water status were analyzed in plum production (*Prunus domestica* L 'Tophit plus'/Wavit) targeting (i) the spatial characterization of the soil ECa, (ii) instantaneous water status of trees, and (iii) cumulative pattern considering yield and fruit quality.

Material & Methods

The plum orchard is located on a hill (3.15°) in temperate climate (Potsdam, Germany), capturing 0.37 ha with 156 trees. The ECa of the topsoil (0-0.25 m) was measured using a Wenner array with the center at the tree stem with a resistivity meter (4-point light hp, LGM, Germany). Plant measurements were carried out on each tree. Laser scanner (ALASCA XT, IBEO Automobile Sensor GmbH, Germany) was employed to measure the leaf area ratio [hits/tree]. The leaf water potential [MPa] was recorded by means of a pressure chamber (Plant water status console 3000, Soilmoisture Equipment Corp, Santa Barbara, USA). Thermal radiation of the canopies was measured by thermal imaging (ThermaCam SC 500, Flir Systems, USA). From the thermal images the crop water stress index, CWSI, was calculated (Ben-Gal, et al., 2009; Jones, 1992). Soluble solids content and size of fruit [°Brix], and overall yield [kg/tree] were measured at harvest date. Statistical analyses were carried out using the statistical package for MATLAB® (R2010B, MathWorks, U.S.) and the free algorithms for spatial analysis (Ferstl, 2007; Peeters et al., 2014).

Results & Discusion

The soil ECa showed small scale variability in the range 1.3 mS/m to 76.7 mS/m. In our study, spatial pattern of ECa were correlated with leaf water potential, CWSI, yield, and fruit quality. The regression analysis showed high adjusted coefficient of determination, R^2_{adj}, considering soil ECa and CWSI at R^2_{adj} = 0.72, leaf area ratio at 0.77, while lower coefficients were found for yield and fruit quality (Käthner and Zude-Sasse, 2015). The preliminary results of ANOVA considering CWSI show differences with F = 4.43 (p = 0.038) and yield with F = 6.70 (p = 0.001).

Conclusion

Spatial variability of CWSI as well as leaf area ratio showed higher correlation coefficients with yield and quality. Fruit quality was affected by soil ECa, as well as instantaneous water status and crop load. Following, the water status of trees will be analyzed considering a physiological drought stress due to high crop load.

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