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Influence of Soil Variability and Topography on Plant Growth and Yield Parameters in *Prunus Domestica* Orchard

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1. INTRODUCTION

Precision Fruticulture addresses site or tree adapted crop management. As a prerequisite, spatially organized data are needed that might include orchard topography and information on the plant water status. In the present study, the influences of terrain elevation, soil electric conductivity, and apparent plant water status on yield parameters were studied in plum trees (Prunus domestica 'Tophit plus'/Wavit).

1.1 Materials

The orchard located on a hill (3.15°) in a terrain 42 m above the sea level in temperate climate (Potsdam, Germany), captured 0.37 ha of plum trees. The plantation consists of six rows with a total of 156 plum trees with 5 m between rows and 4 m between plants in the row. Elevation was measured with RTK-GPS (HiPer Pro, Topcon Corporation, Japan) per tree. The elevation model was developed using a combination of natural nearest neighbour interpolation and triangulation tool from MATLAB® (R2010B, MathWorks, U.S.) and converted to a grid surface map with a 0.5 m spatial resolution. With the geoelectrical method (4-point light hp, LGM, Germany) an area of 192.0 x 37.5 x 2.0 m captured. In the present study, soil electrical conductivity (ECa) values were interpolated and considered on the tree level only.

1.2 Methods

Plant measurements were carried out in 2011 and 2012 on each tree. Trees were subjected to rating (flower set [#/tree], fruit set [#/tree], fruit drop [#/tree], yield [#fruits/tree], fruit size [mm], number of yellow leaves at harvest time [#/tree], fruit flesh firmness [N/cm²], fruit pigment contents, NDVI [0;1] and NAI [1;0]). To detect the leaf water potential [MPa] a scholander bomb was used, while trunk diameter, leaf

also fruit fresh and dry masses were collected manually. In 2012, thermography images (320 x 240 pixel) providing a frame of 2.14 m x 2.14 m (ThermaCam SC 500, Flir Systems, USA).

2. Statistical analyses

For statistical analyses the rating data were transformed into a normal distribution using an appropriate variance-stabilizing method that was achieved by the root of the rating data. The linear correlation analysis between elevation, ECa (topsoil, root zone, subsoil), canopy images, and rating parameters were carried out in statistical package for MATLAB® (R2010B, MathWorks, U.S.). The multi-way analysis of variance (ANOVA) was applied for testing the effect of multiple factors on the means of the plant parameters.

3. Results

In our study the elevation of the terrain had a similar impact on the yield and fruit quality. The ECa in the topsoil and elevation were correlated with the fruit set at R=0.17 (p=0.01) and -0.45 (p=0.13), fruit drop at -0.10 (p=0.006) and 0.51 (p=0.03). The preliminary results from the leaf water potential show significant differences between predawn and midday measurements and also between the different measurement days. A spatial and temporal correlation was found in the orchard. Consequently, based on the spatial pattern of yield parameters found in stone fruit, site-specific management appears reasonable.

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