P32 – Improving high throughput sensor-based data acquisition of breeding material

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Abstract

Grapevine is a perennial woody plant whose characteristics, in addition to marker-assisted selection (MAS) on resistances, are mainly recorded in the field during the breeding steps. For material selection in breeding long-term observation and recording of the overall vitality, yield, phenology, growth architecture, resistance against diseases, and quality is done. However, the time window for recording characteristics during the growing season is narrow and the evaluation capacity is limited due to manual assessment. Thus, phenotypic characteristics cannot be documented in detail for early breeding stages for the large number of breeding material, which leads to a lack of information about the selected genotypes and later no retrospective data analysis of individual genotypes is possible. Therefore, a novel high throughput determination system is needed to increase the efficiency of phenotyping and to optimize data management within the breeding program. In the present study, the expanded phenotyping platform "Phenoliner 2.0" and the steps to develop such a phenotypic pipeline for breeding are shown. The platform, which is equipped with a prism-based simultaneous multispectral camera system consisting of a visible color channel and two near-infrared channels, was developed and tested in the vineyard to acquire images and spectra of grapevines. Compared to the previous version, the speed of data acquisition has been improved from one kmh to four kmh. The assignment of the sensor data is based on GPS information of the vine locations, which are recorded by a real-time kinematic GPS receiver mounted on the phenoliner. With the help of a plant detection algorithm, the absence of vines can be recognized and documented automatically. In order to develop the image analysis pipeline for the main phenotypic breeding traits: (1) vitality, (2) yield and (3) wood maturity, the system needs to be trained to distinguish among different structures of the grapevine (leaf, grape bunch, and stem) and between healthy and diseased structures. For this purpose, the recorded images were segmented and manually annotated. So far, the annotation software developed in this study is able to automatically recoginze leaf and grape bunch structures in the images and videos. To improve data management, the images and their results could be stored and linked to individual genotype metadata, such as breeding number, planting years, and crossing parents. The system can be applied to map phenotypic parameters of an entire vineyard. The information on vitality, yield, ripening, and resistances is important for further breeding steps and viticulture.

Keywords: grapevine, phenotyping, sensor, data management, annotation, healthy, diseased