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Moving Fields - Using high-throughput phenotyping to select winter barley for the production of biogas

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Abstract

Winter barley (*Hordeum vulgare*) lends itself well for crop rotation, as it can be harvested earlier than most other winter crops. As such, it holds potential to contribute to the production of biogas from whole crop silage. To select candidates promising for further breeding, we compared the biomass production of 48 winter barley varieties. Creating 8 replicated 'fields' per genotype, we planted these varieties in 384 boxes (0.1 m^2×20 cm deep), at a density of 300 plants per m^2. After vernalization, we photographically captured biomass production throughout development using the 'Moving Fields' high-throughput phenotyping installation (LemnaTec, Aachen, Germany). Built into a greenhouse, this installation consists of a conveyor belt system (Bosch Rexroth TS 2 plus; capacity: 390 carriers), 3 measuring stations and 4 photo cabins (LemnaTec Scanalyzer 3d), which together enable fields to be automatically moved, watered, weighted and photographed. Using RGB cameras (2456×2058 px) in visual light range (300-700 nm) and RGB cameras (1390×1038 px) capturing fluorescence, we documented plant growth on a weekly basis. A preliminary comparison using images made by the RGB cameras in the visual light range demonstrated that growth of the 48 genotypes could be traced non-invasively, pointing at genotypic differences in biomass production over time. Analysis of dry weight biomass at harvest confirmed six-rowed genotypes to be generally heavier than two-rowed genotypes. Despite both considerable variation within genotypes and considerable overlap between genotypes, weight differences of various genotypes were statistically significant. Variety 'Titus', for instance, harvested significantly more biomass than all other genotypes except 'Highlight', whereas 'Anisette' developed significantly less biomass than all but three genotypes.

Keywords
Biomass, *Hordeum vulgare*, image analysis, renewable energy

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