PROJECT TITLE

Plant-plant competition and canopy productivity

CONSORTIUM

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SUMMARY OF THE REPORT

Plant-plant competition (PPC) may reduce potential productivity under high planting density. Despite the importance of PPC, experimental methods quantifying the effects of PPC on plant performance are astonishingly scarce until today and our knowledge about PPC is still very restricted. In this project, we used a panel of 200 wheat cultivars that represents breeding history of German winter wheat released between 1966 and 2016 to study the plant-plant competition at seedling stage. Three degrees of intra-genotypic plant-plant competition were realized by changing the plant density (1, 3 and 9 plants per pot) in the platform PhenoArch. In total, 2400 pots were imaged daily over a course of three weeks after germination. Preliminary results from the image analyses and ground-truth measurements show the high quality of our data set. Upcoming image analyses and process-based and functional-structural modelling approaches will allow us to derive the phenotypic plasticity of at least 11 categories of traits in response to plant density: 1) plant height and plant elongation rate, 2) tiller number and tiller development rate, 3) total leaf area and leaf expansion rate, 4) fresh and dry biomass 5) absolute and relative growth rate of biomass, 6) canopy leaf area distribution, 7) canopy leaf angle distribution, 8) canopy light interception, 9) light extinction coefficient 10) degree of self-shading and 11) water use efficiency. Combining this data set with the published data from the field experiments using the same panel, meta-analyses and genome-wide association studies can obtain further physiological insights into the German breeding history and how it has affected the phenotypic plasticity of traits related to PPC in the modern elite cultivars. We expect to provide plant breeders with a novel guideline to avoid selection bias due to plant-plant competition and to understand the impact of architectural plasticity on canopy light interception, productivity and plant-plant competition using in silico experiments.