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Substantial genetic yield gap estimated for wheat in Europe

Mikhail Semenov and Nimai Senapati

Rothamsted Research, Harpenden, Hertfordshire, AL5 2JQ, UK

Improving yield potential and closing the yield gap are important to achieve global food security. Europe is the largest wheat producer, delivering about 35% of wheat globally, but European wheat's yield potential from genetic improvements is as yet unknown. We estimated wheat 'genetic yield potential', i.e. the yield of optimal or ideal genotypes in a target environment, across major wheat growing regions in Europe by designing *in silico* ideotypes. These ideotypes were optimised for current climatic conditions and based on optimal physiology, constrained by available genetic variation in target traits. A 'genetic yield gap' in a location was estimated as the difference between the yield potential of the optimal ideotype compared with a current, well-adapted cultivar. A large mean genetic yield potential (11–13 t ha⁻¹) and genetic yield gap (3.5–5.2 t ha⁻¹) were estimated under rainfed conditions in Europe. In other words, despite intensive wheat breeding efforts, current local cultivars were found to be far from their optimum, meaning that a large genetic yield gap still exists in European wheat. Heat and drought tolerance around flowering, optimal canopy structure and phenology, improved root water uptake and reduced leaf senescence under drought were identified as key traits for improvement. Closing this unexploited genetic yield gap in Europe through crop improvements and genetic adaptations could contribute towards global food security.