Tropentag, September 17-19, 2018, Ghent

"Global food security and food safety:
The role of universities"

Closing Yield Gaps in Wheat Production in Iran through Site-specific Management: A Modelling Approach

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Abstract

Wheat is the first strategic crop in Iran where cultivated 2.6 Mha under irrigated and 3.6 Mha on the rainfed system with average production of 11.2 Mt (7.0–15.9 Mt) per year. To increase wheat production require sustainable intensification of existing farmlands to minimise the undesirable effects of agriculture on the environment. We hypothesised that wheat yields, and water and nitrogen use efficiencies could be significantly increased through site-specific management, thereby reducing yield gaps in the region. Through a combined approach of simulation modelling in 28 sites in 11 major wheat-producing domains across Iran from 1998 to 2013, we were able to quantify wheat yield gaps and yield responses to management including planting date, plant population, and water and nitrogen applications. The CERES-Wheat model was calibrated and validated for the diverse environments of Iran. By Seasonal Analysis tools in DSSAT v4.7 software packages best site-specific management was optimised for each location to achieve high yields. The gap between yield potential and actual yield was a range of 2.0 to 6.7 Mg ha^{-1} depend on locations. The finding of the study was that insufficient irrigation largely limited wheat yield in Iran. Considering that access to more water resources in Iran is not possible, but irrigation management including changing irrigation method and reducing the amount of irrigation per application could increase water use efficiency and yield by 43 percent. Meanwhile in some locations yield was limited by nitrogen especially the time of N application. Also, at sites with short wheat growing season increasing in plant population and delay in planting date increased the yield by 18 % and 26 %, respectively. On the contrary, at locations with long wheat growing season, early planting date and splitting N application increased the yields by 24 % and 22 %, respectively. Thus, doubling wheat production would be feasible using these managements without application of more irrigation. We conclude that site-specific management has the potential to close existing yield gaps in the wheat production systems in Iran by improving yield and profitability.

Keywords: Crop modelling, dSSAT, Management, Seasonal analysis, Wheat, Yield gap

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