Agronomical strategies for wheat productivity and food security in Afghanistan

Q. Soofizada [(1)], A. Pescatore [(1)], S. Orlandini [(1,2)], M. Napoli [(1)]

[(1)] Department of Agriculture, Food, Environment and Forestry (DAGRI), University of Florence, Piazzale delle Cascine 18, 50144 Florence, Italy

[(2)] Fondazione per il Clima e la Sostenibilità, Via G. Caproni 8, 50145 Florence, Italy

* Corresponding author: marco.napoli@unifi.it

Afghanistan's common wheat (*Triticum aestivum*, L.) production faces significant challenges due to alkaline soils, low organic matter, limited phosphorus availability, and arid to semi-arid climatic conditions. This study evaluated the impact of pedoclimatic factors and agronomic practices on wheat yield and quality. The research was conducted over two growing seasons (September 2020 to July 2022) in four locations, each representing different agro-climatic zones of Afghanistan. Field experiments involved 27 treatments with three replicates, based on a factorial combination of three phosphorus levels (60, 90, and 120 kg P_2O_5 ha^{-1}), three nitrogen-to-phosphorus ratios (1:1, 1.25:1, and 1.5:1), and three common wheat varieties—Darulaman-07, Kabul-13, and Zardana-89. Soil pH was identified as a key limiting factor, reducing nutrient availability and yields in highly alkaline soils. However, agronomic management emerged as the most influential factor, significantly improving grain yield, protein and starch quality, and gluten strength. A balanced application of N and P (120 kg P_2O_5 ha^{-1} with an N:P ratio of 1:1) increased grain yield by 29% and starch yield by 31%, while higher N ratios (1.5:1) enhanced protein and gluten concentrations. Across all locations, applying 50 kg P_2O_5 ha^{-1} was sufficient to support wheat production in terms of quantity and quality. To optimize phosphorus efficiency, especially in soils with pH above 7.3, it is recommended to apply phosphorus at planting, banded with or near the seeds. Among the tested varieties, Darulaman-07 demonstrated the highest yield potential, amylopectin content, and the lowest amylose-to-amylopectin ratio (AM:AP), making it a valuable option to address starvation and malnutrition in Afghanistan. Zardana-89 excelled in gluten strength, making it ideal for baking, while Kabul-13 stood out for its starch concentration and AM:AP ratio, suitable for addressing health-related dietary needs. Key quality parameters measured included gluten concentration, amylopectin content, and the AM:AP ratio, which are critical for both nutrition and food processing. The findings of this research have substantial implications for Afghanistan's agriculture, food security, and environmental sustainability. By integrating site-specific fertilization practices and promoting resilient wheat varieties, this study offers a pathway to reduce the country's reliance on wheat imports while improving dietary outcomes. Enhancing wheat productivity also contributes to better resource efficiency, minimizing the overuse of fertilizers and reducing the environmental footprint of farming. Additionally, these strategies can empower Afghan farmers by increasing income stability and promoting sustainable land management practices. This research offers a roadmap for improving wheat productivity and quality in Afghanistan, addressing food security challenges and fostering long-term environmental resilience. Future studies should expand these findings to encompass diverse climatic conditions and longer-term assessments to fully realize their transformative potential.

Keywords

Resilient common wheat varieties; phosphorus fertilization; amylopectin content; grain yield improvement; nutrient efficiency

Reference: Soofizada, Q., Pescatore, A., Orlandini, S., & Napoli, M. (2023). Effects of Pedoclimate and Agronomical Management on Yield and Quality of Common Wheat Varieties (*Triticum aestivum* L.) in Afghanistan. Agronomy, 13(8), 2152. https://doi.org/10.3390/agronomy13082152