Proceedings of the LXIV SIGA Annual Congress
Online, 14/16 September, 2021
ISBN: **978-88-944843-2-8**

Oral Communication Abstract – 7.07

GENOMICS-DRIVEN BREEDING FOR LOCAL ADAPTATION IS ENHANCED BY FARMERS' TRADITIONAL KNOWLEDGE

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genomic selection, breeding, wheat, smallholder farming, genomics

The climate crisis is ushering crop breeders to accelerate the development of new varieties with local adaptation traits. The use of genomics allows to pinpoint molecular mechanisms underlying complex traits and to predict genomic estimated breeding values through genomic selection (GS). To fulfill GS potential in breeding for local agriculture, genetic diversity data must be coupled with meaningful phenotypic data. This is critical in challenging environments, where the limiting buffering capacity of smallholder agriculture results in marked differences in agronomic performances of recommended varieties. Here, we focus on durum wheat to show that participatory variety selection (PVS) may be used in combination with locally adapted germplasm to support GS in diverging environments. We compare the predictive ability of grain yield (GY) with that of overall appreciation (OA) provided by smallholder farmers in a PVS experiment evaluating 10,400 plots, finding that farmer evaluations can predict yield in untested environments with higher accuracy than agronomic measures. We then describe a data-driven decentralized breeding approach called 3D-breeding that brings the selection in the farmer fields, leveraging crowd-sourced observations of crop performance to enhance the accuracy of GS. 3D-breeding was run in 1,165 smallholder farmers' field, each evaluating three landrace varieties and an improved line for OA. GY measures were also collected in farmer plots at the end of the growing seasons. The prediction accuracy of 3D-breeding was evaluated against a benchmark representing centralized breeding approaches, showing that our centralized methods could double the accuracy of GS. We describe the added value of harnessing smallholder farmers' traditional knowledge in prioritizing pre-breeding materials for local agriculture, breaking down farmers' OA by gender and location in relation to agronomic traits. Our results support the value of incorporating PVS in GS approaches to enhance genetic gain for local agriculture, using decentralized approaches to dully harness the potential of genomics-driven breeding.