Cross-disciplinary efforts to support crop improvement in complex SAT environments

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Crop production is the consequence of crop x management x environmental (GxMxE) interactions. This complexity frequently prevents breeding progress from keeping the pace with the increasing demand for the crop production quantity and quality, especially in the harshest production environments of the globe (e.g. semi-arid-tropics; SAT). Yet, novel methods and tools are being developed to decipher and understand complexities of the target crop production systems and bridge the existing production and nutrition gaps with the appropriate GxM interventions.

In the presented work, we will describe the current ICRISAT efforts to integrate the key disciplines to design and develop the elite material with higher production/resilience/quality for the harshest SAT environments. We will emphasize the importance of clear product definition which should be supported by the quantitative analysis of bio-geo-physical properties of target population of environments (TPE) for which the product is being developed. We will demonstrate how the later can be achieved at the relevant spatio-temporal scale using the crop growth simulation tools and how the crop simulation models could further support definition of phenotyping (G) and crop management (M) targets for TPE. This insight should eventually lead to the development of relevant and cost-effective high-throughput phenotyping methods which should be incorporated into the crop product development pipelines in order to test and introduce the novel products to the target geographies with the suitable agronomic practices. However, many of these tools (modelling, trait-phenotyping) are usually very complex, time and cost-consuming to be easily exploited by the crop improvement teams and therefore we will discuss the current strategy to comprehensively enable and integrate the essential technologies into the breeding pipelines.

Finally, we will summarize on the current efforts to streamline the crop qualitative parameters into the breeding pipelines and so address the malnutrition issues frequently accompanying the system production constraints in SAT.